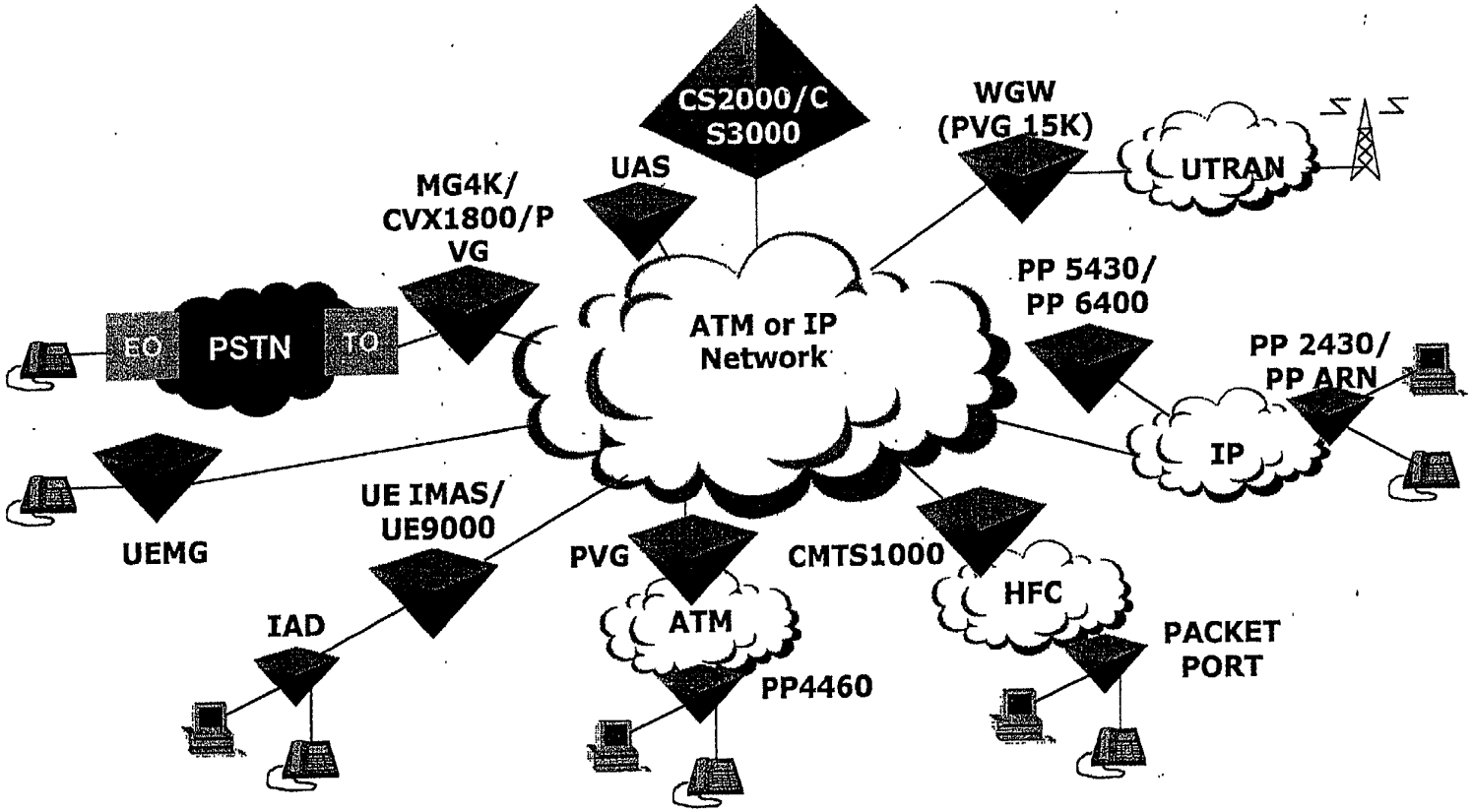
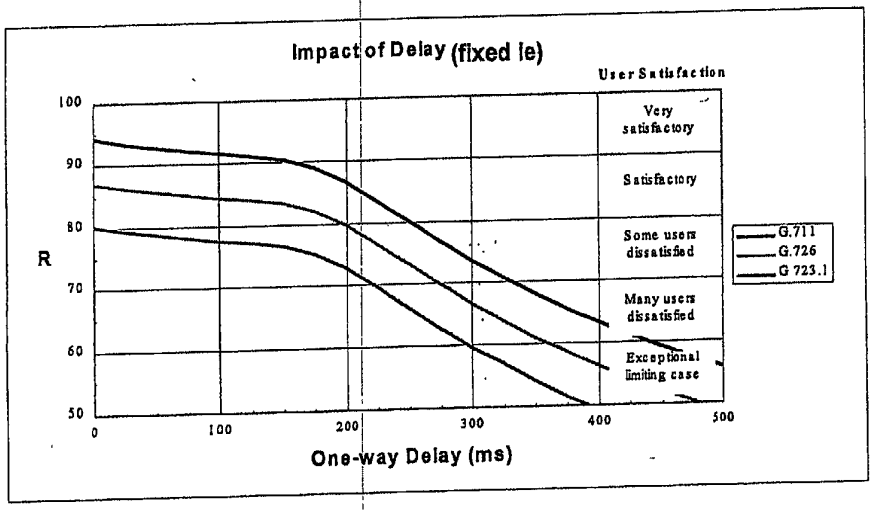
FOSTER 050525CD

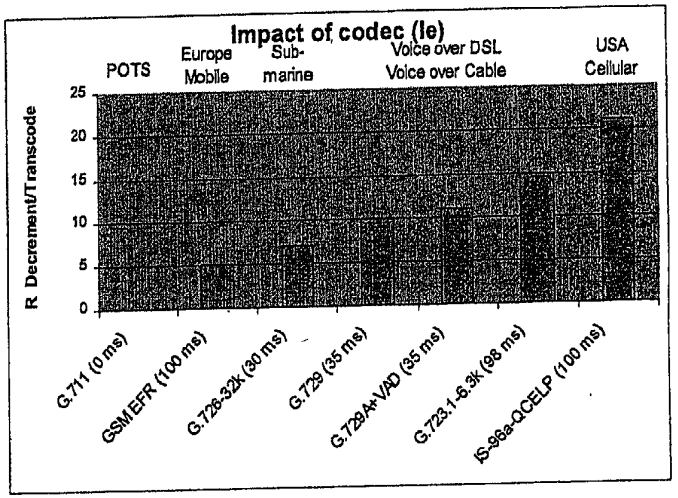
Fig. 1



BOSTON 03014260

Fig. 2





POSTAL OBSERVER

Fig. 3

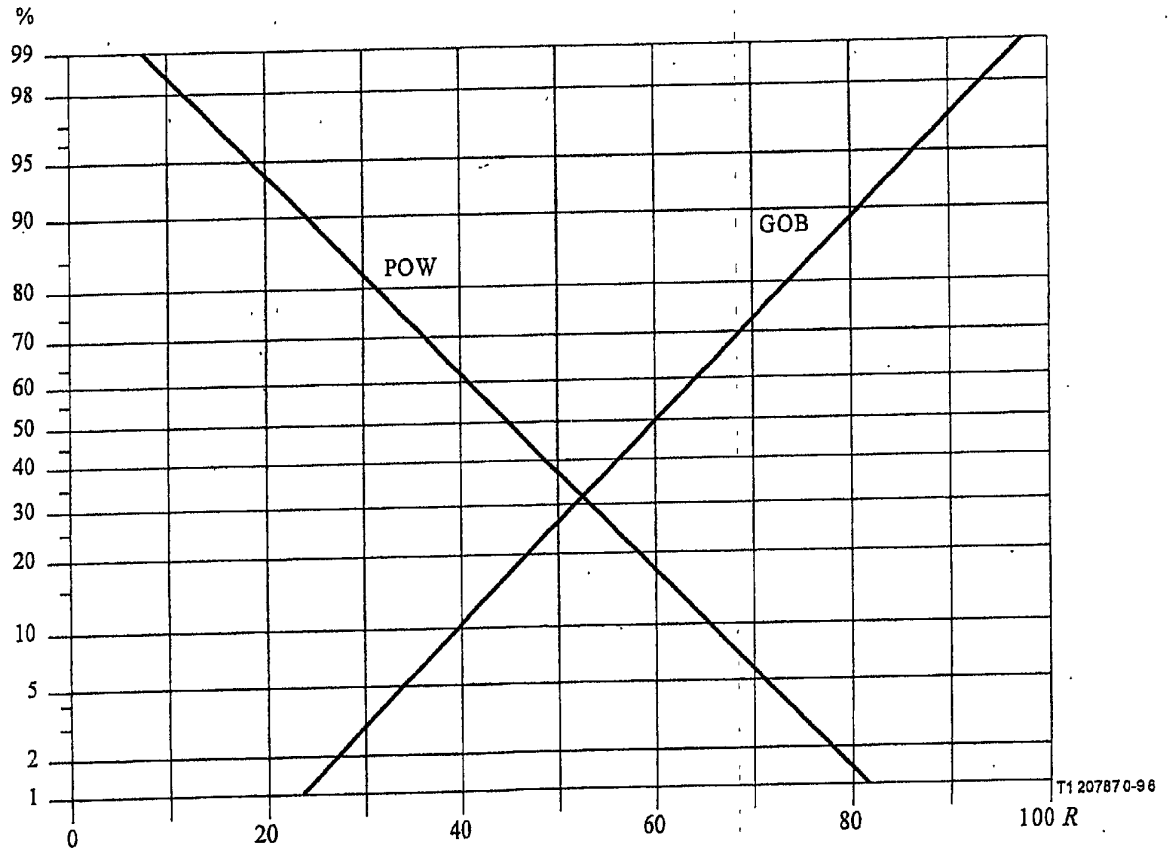


Figure B.1/G.107 - GOB (Good or Better) and POW (Poor or Worse) as functions of rating factor R

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Fig. 4

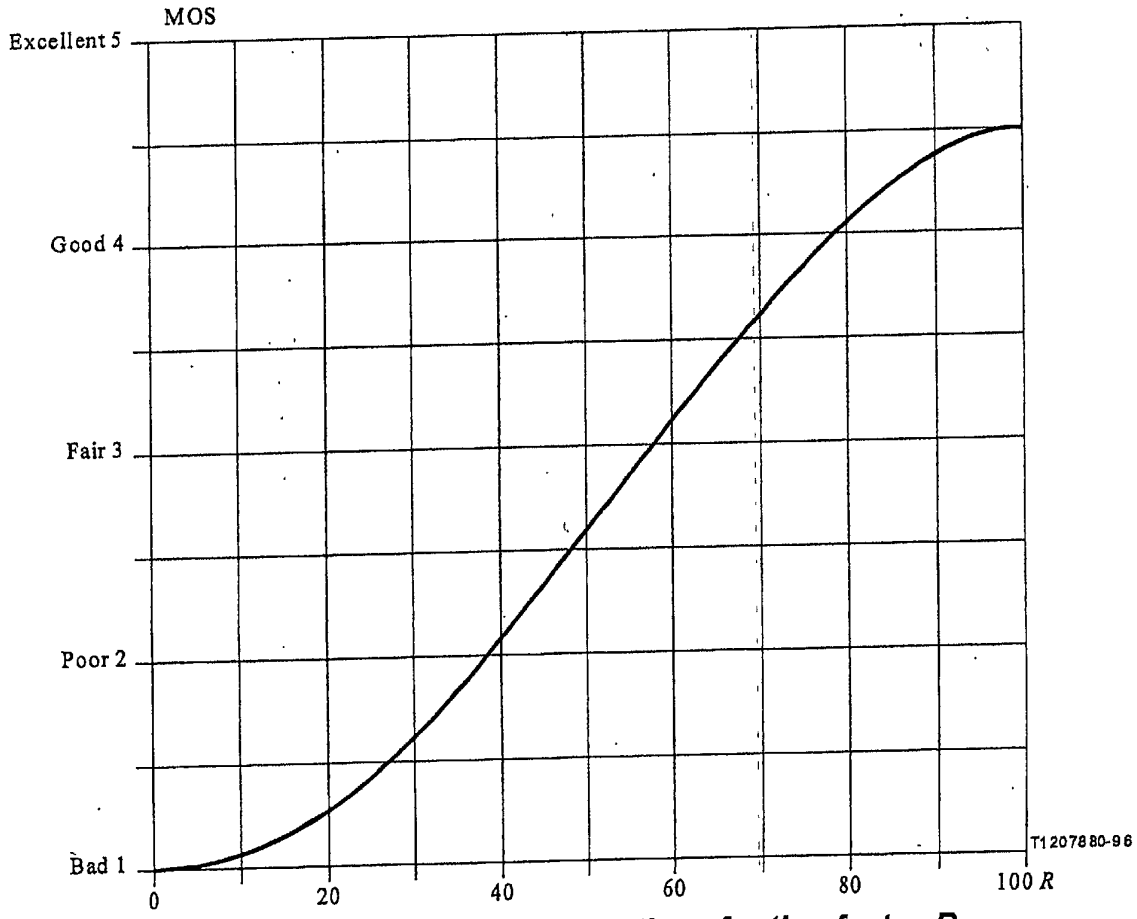


Figure B.2/G.107 – MOS as function of rating factor *R*

Fig. 5

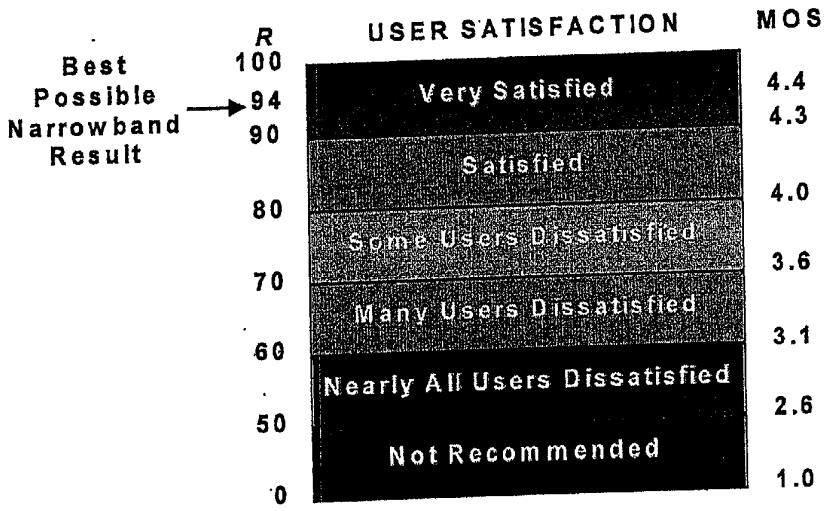

R
USER SATISFACTION
MOS
Best Possible Narrowband Result
100
94
90
80
70
60
50
0
Very Satisfied
Satisfied
Some Users Dissatisfied
Many Users Dissatisfied
Nearly All Users Dissatisfied
Not Recommended
4.4
4.3
4.0
3.6
3.1
2.6
1.0

Fig. 6

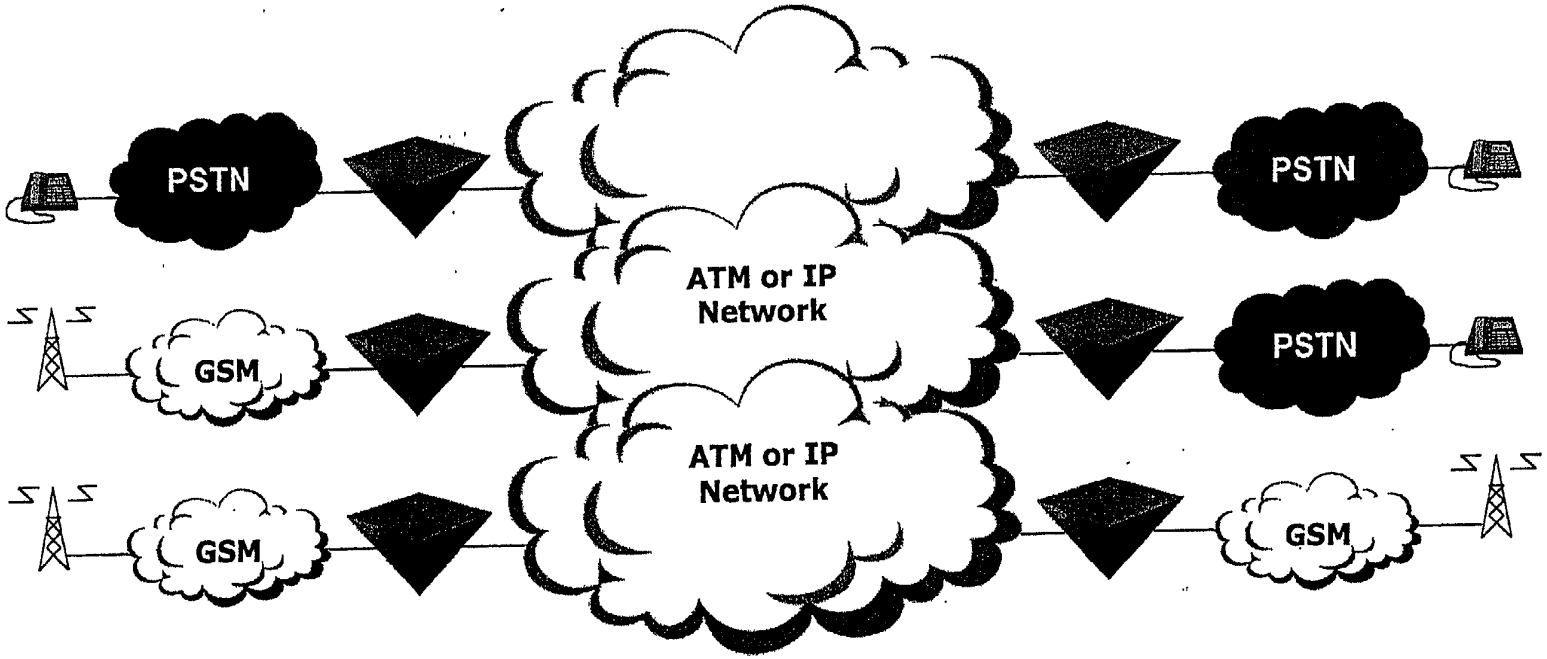
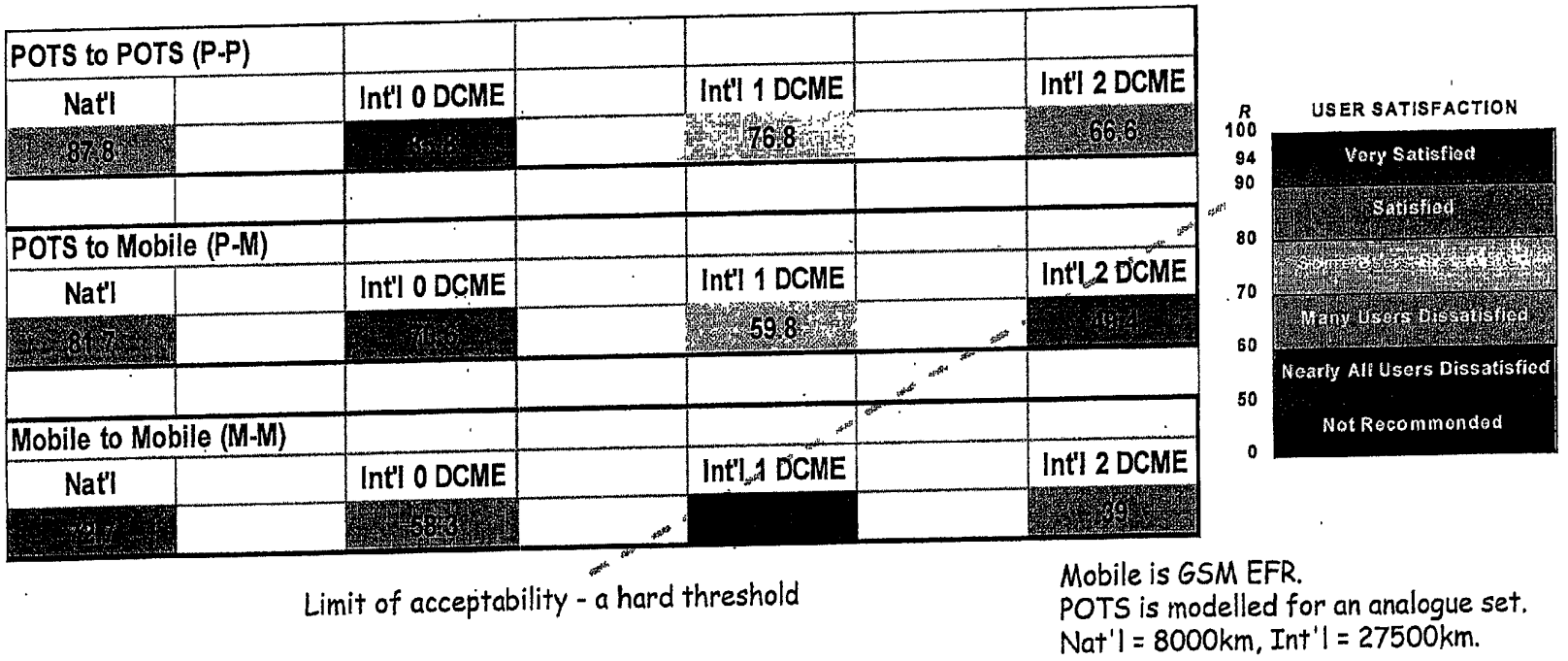


Fig. 7

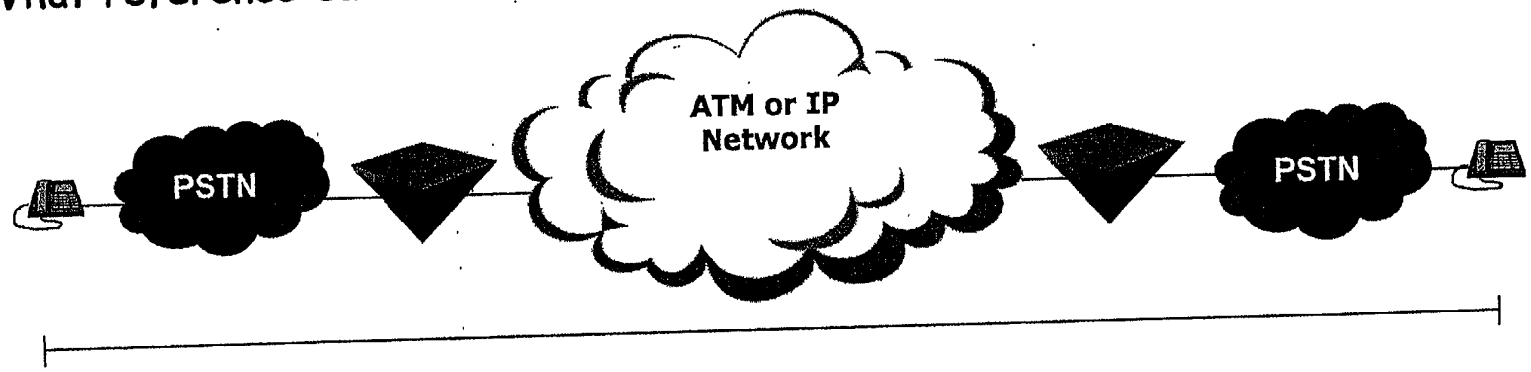


Limit of acceptability - a hard threshold

Mobile is GSM EFR.
POTS is modelled for an analogue set.
Nat'l = 8000km, Int'l = 27500km.

Fig. 8

What reference calls will be the most demanding quality measure?



EP 0 901 259 A2

Fig. 9

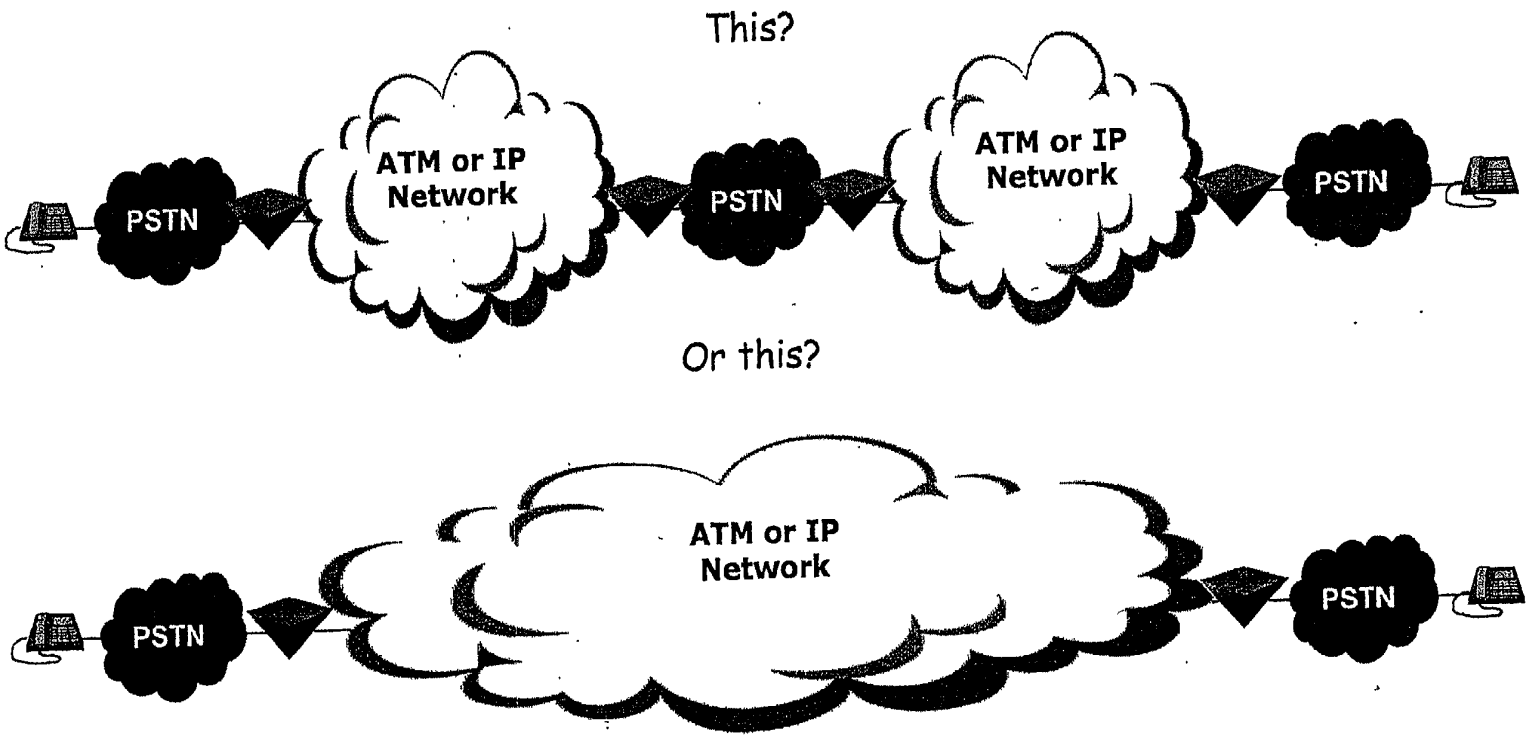


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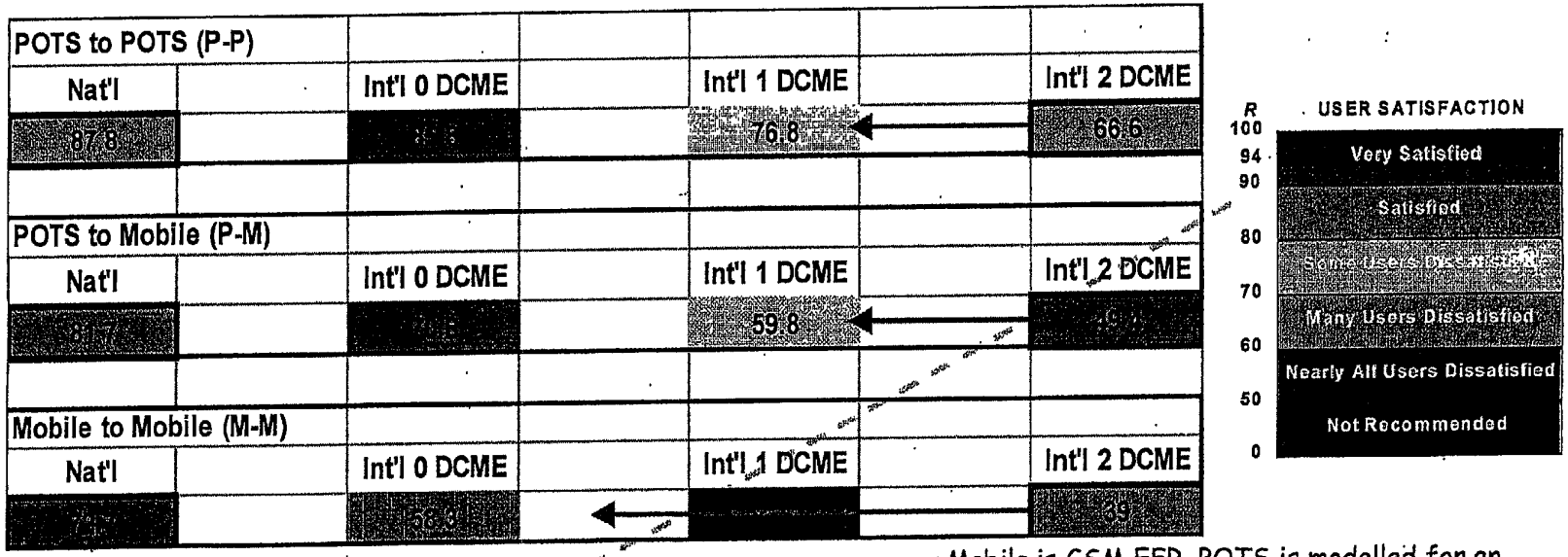
Fig. 10

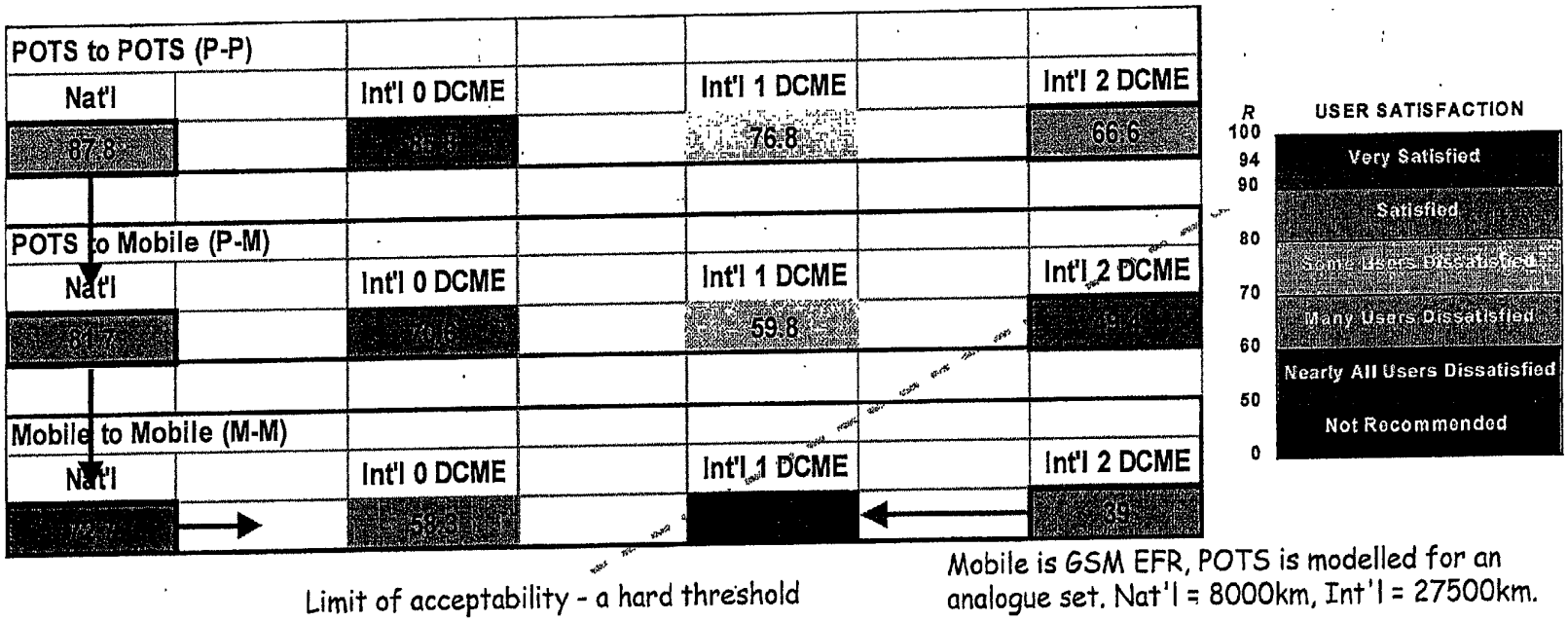


Limit of acceptability - a hard threshold

Mobile is GSM EFR, POTS is modelled for an analogue set. Nat'l = 8000km, Int'l = 27500km.

(*5R = 0.2 MOS over most of the linear range considered in the statistical noise by many practitioners.)

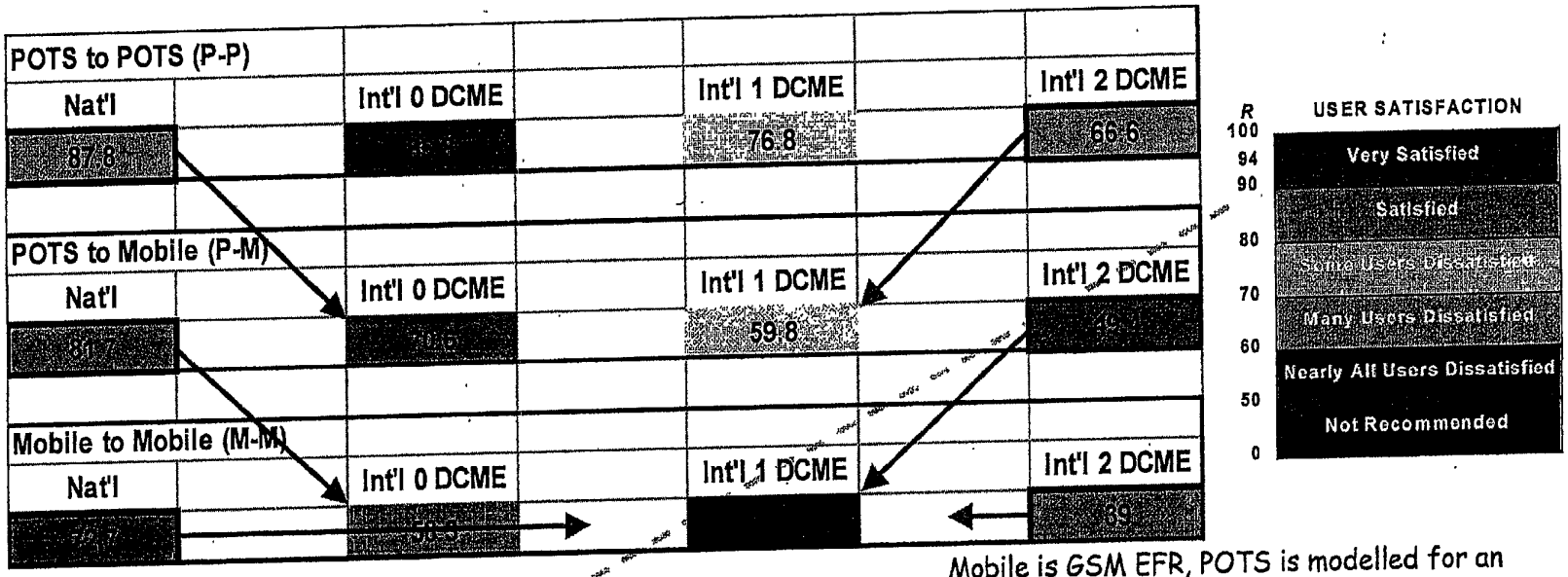
Fig. 11



Limit of acceptability - a hard threshold

Mobile is GSM EFR, POTS is modelled for an analogue set. Nat'l = 8000km, Int'l = 27500km.

Fig. 12



Limit of acceptability - a hard threshold

Mobile is GSM EFR, POTS is modelled for an analogue set. Nat'l = 8000km, Int'l = 27500km.

Fig. 13

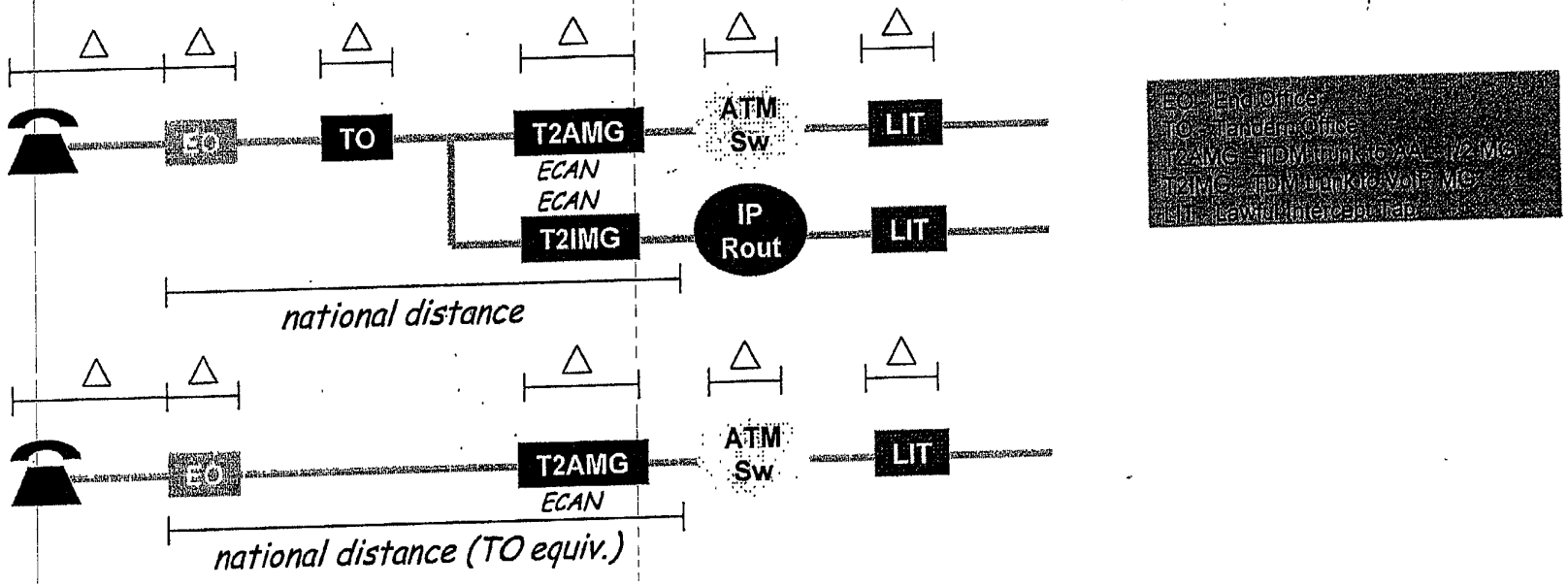

EO
TO
T2AMG
ECAN
ECAN
T2IMG
ATM Sw
IP Rout
LIT
LIT
national distance
EO
T2AMG
ECAN
ATM Sw
LIT
national distance (TO equiv.)
EO: End Office
TO: Tandem Office
T2AMG: TDM Trunk to ATM T2 MG
T2IMG: TDM Trunk to VoIP MG
LIT: Lawful Intercept Trap

Fig. 14

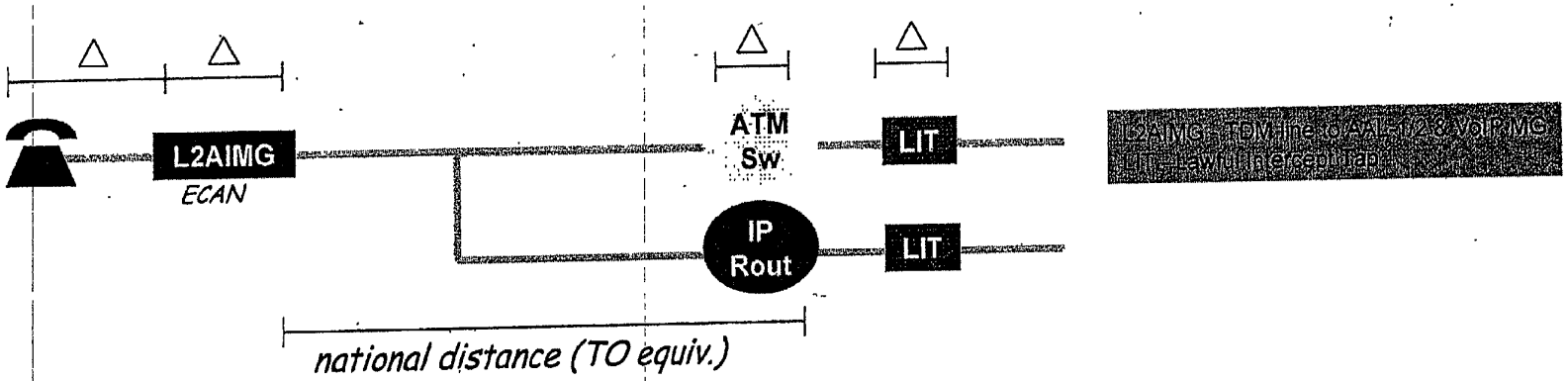
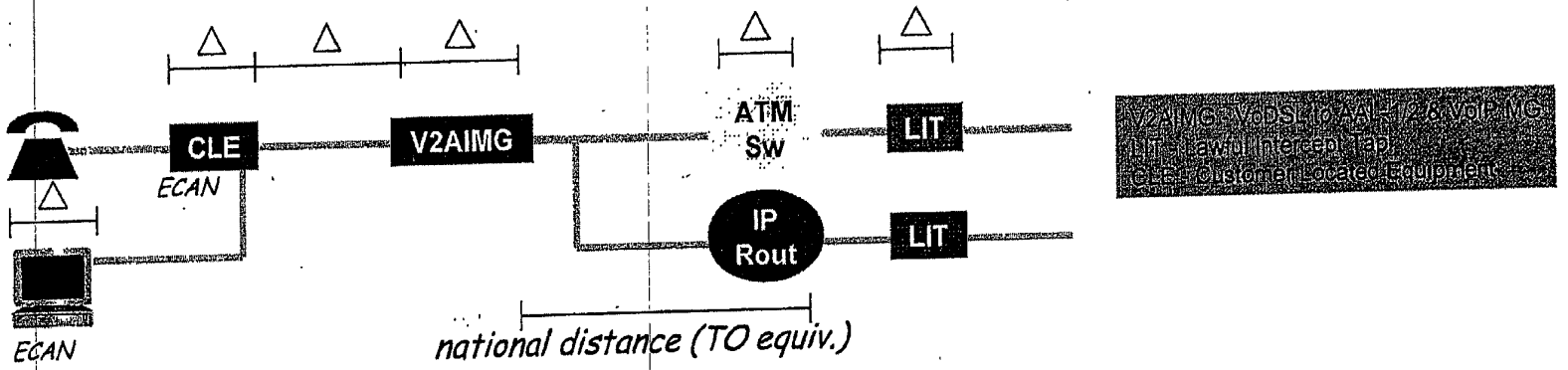

L2AIMG
ECAN
ATM
Sw
LIT
IP
Rout
LIT
national distance (TO equiv.)

Fig. 15


CLE
ECAN
V2AIMG
ATM
SW
LIT
IP
Rout
LIT
ECAN
national distance (TO equiv.)
V2AIMG: VoDSL to AAL-2 & VoIP MG
LIT = Lawful Intercept Tap
CLE = Customer Located Equipment

FOSTER 030139209

Fig. 16

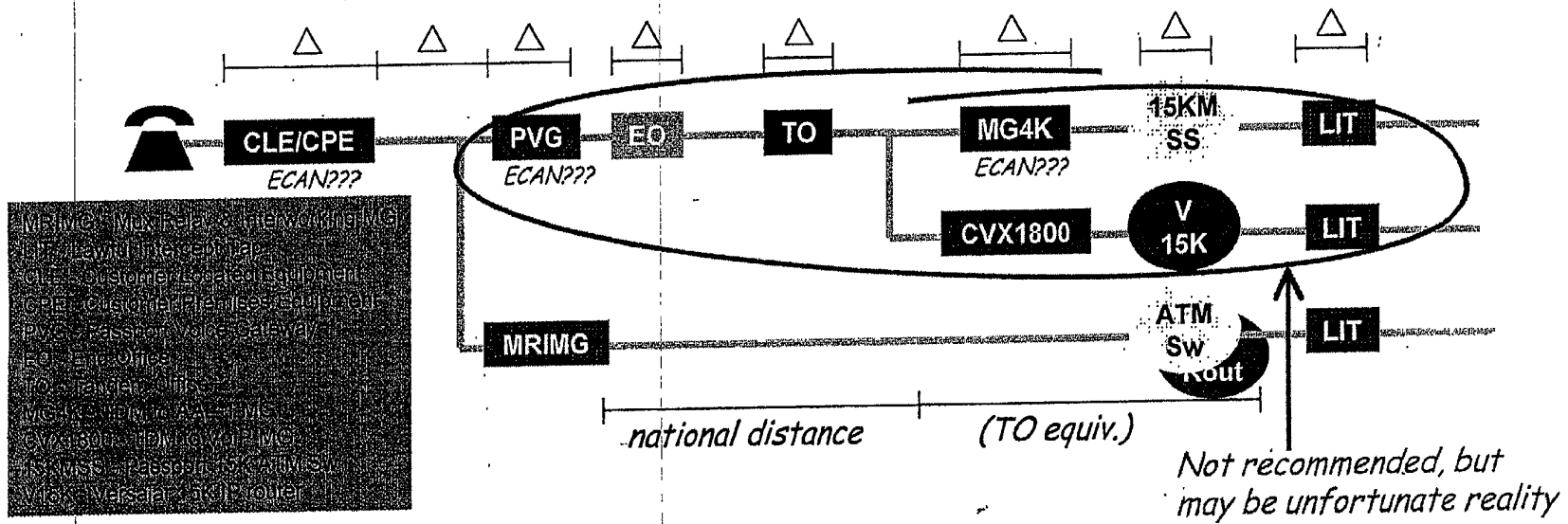
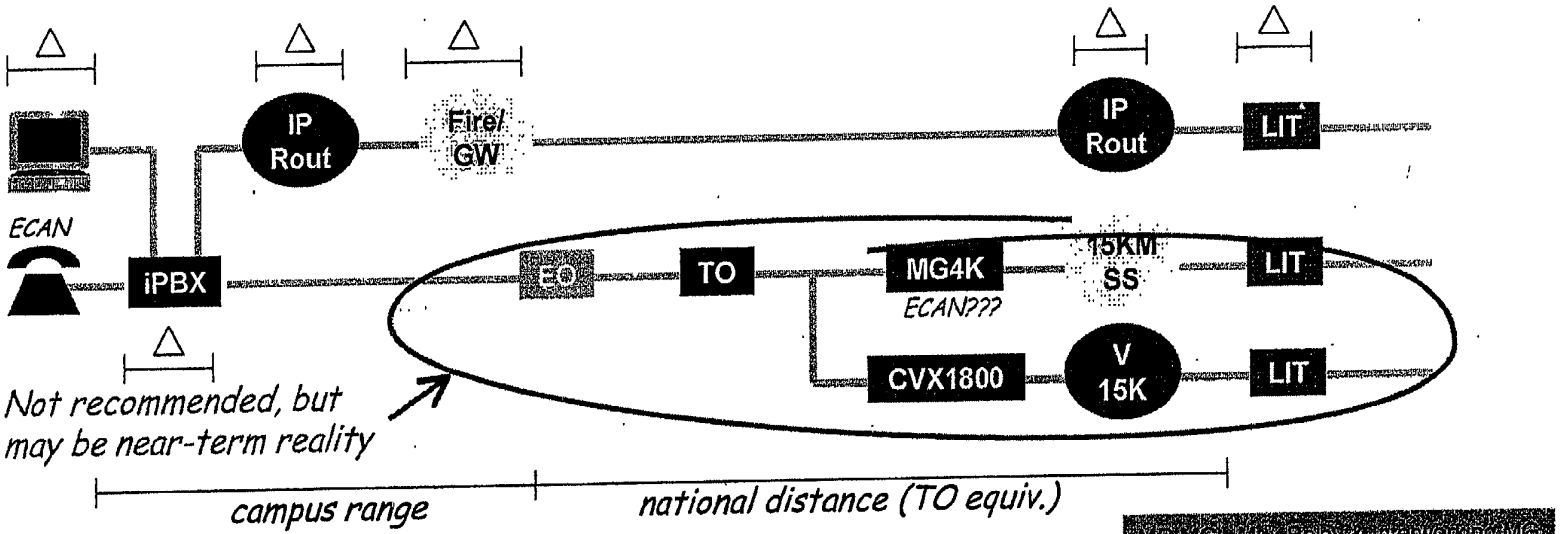
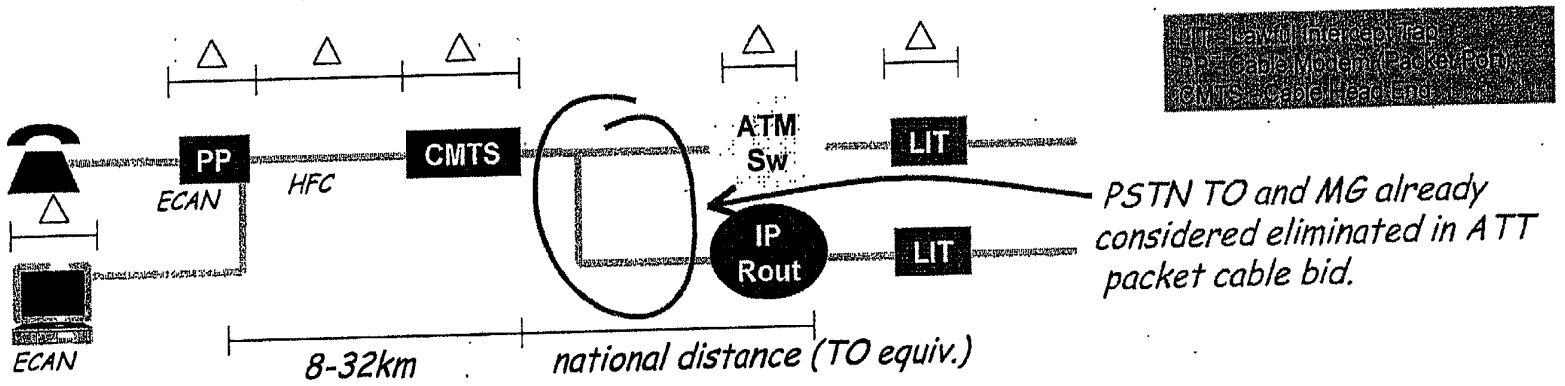


Fig. 17



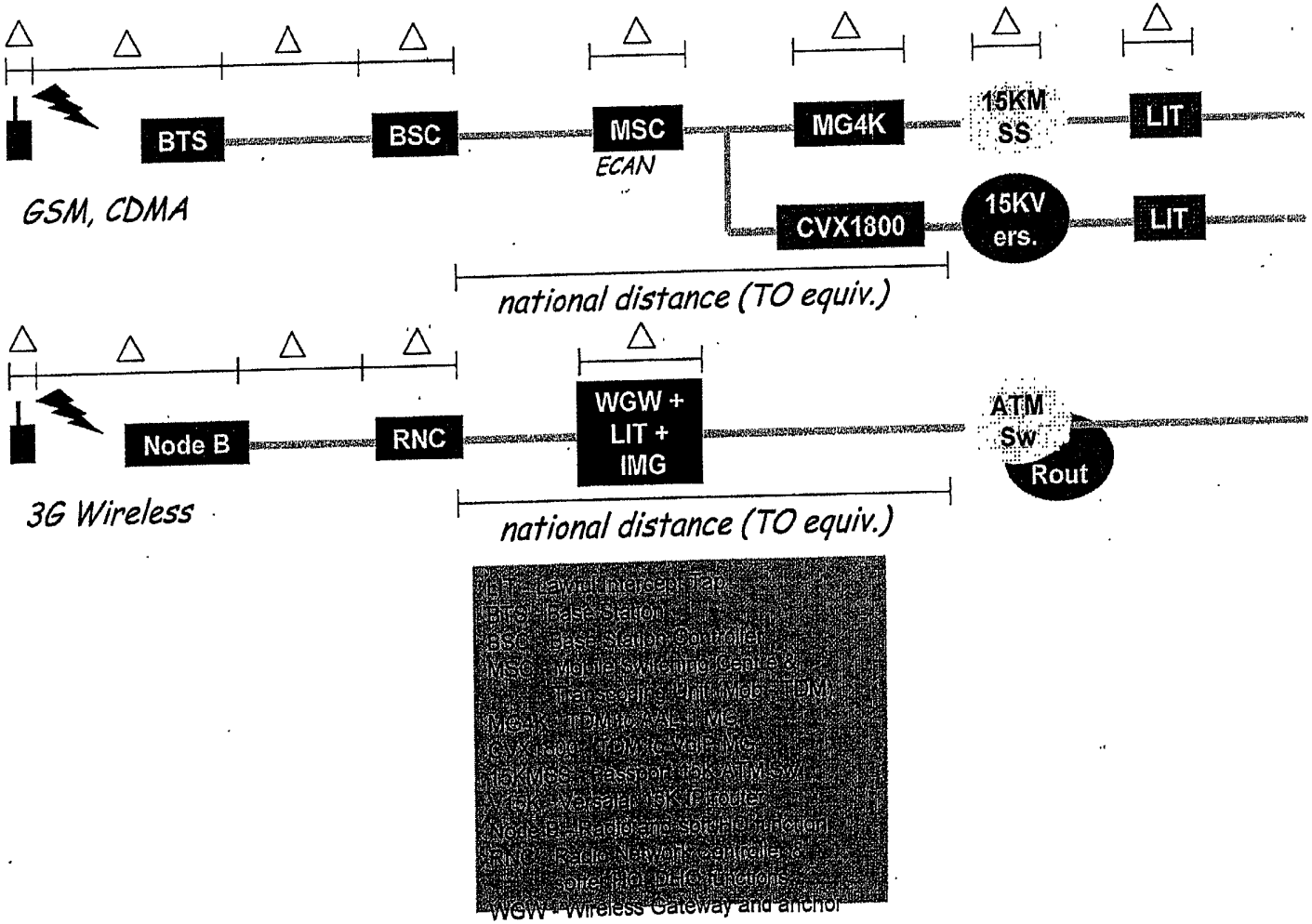
MR MG - Mx Relay & Interworking MG
LIT - Lawful Intercept Tap
CLE - Customer Located Equipment
CPE - Customer Premises Equipment
PVG - Passport Voice Gateway
EO - End Office
TO - Tandem Office
MG4K - DMS TDM to VoIP MG
CVX1800 - TDM to VoIP MG
15KMSS - Passport 15K ATM SW
V15K - Versalar 15K IP Router

Fig. 18


LIT - Lawful Intercept Trap
PP - Cable Modem (Packet Port)
CMTS - Cable Head End
PP
ECAN
HFC
CMTS
ATM
Sw
LIT
IP
Rout
LIT
PSTN TO and MG already considered eliminated in ATT packet cable bid.
ECAN
8-32km
national distance (TO equiv.)

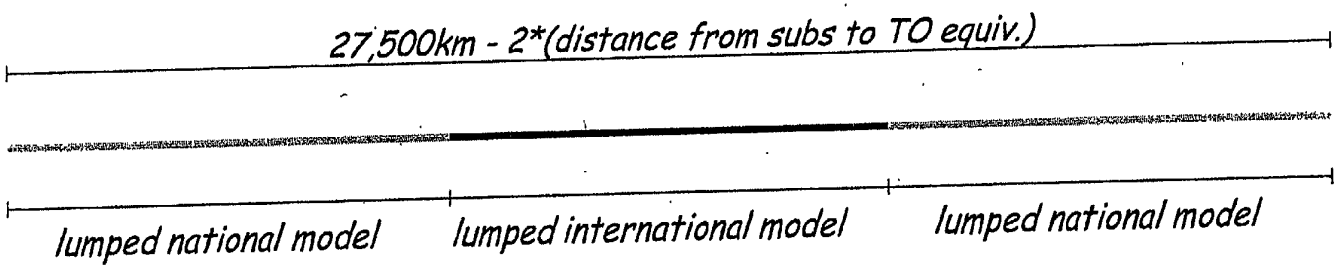
FOREIGN DOCUMENT

Fig. 19



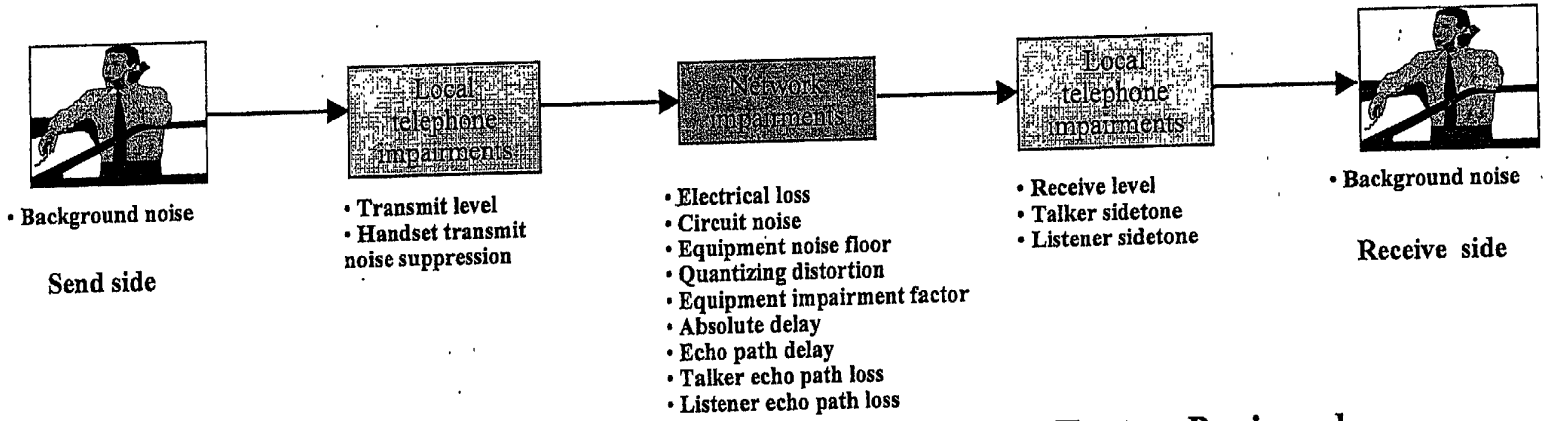
[illegible]

Fig. 20


27,500km - 2*(distance from subs to TO equiv.)
lumped national model
lumped international model
lumped national model

DOCKET ALARM

Fig. 21



The E-model calculates a Transmission Rating Factor *R*, given by

$$R = R_o - I_s - I_d - I_e + A$$

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Fig. 22

E-Model Parameter Default Values

Parameter	Units	Value
SLR (Send Loudness Rating)	dB	8
RLR (Receive Loudness Rating)	dB	2
STMR (Sidetone Masking Rating)	dB	15
LSTR (Listener Sidetone Rating)	dB	18
OLR (Overall Loudness Rating)	dB	10
TELR (Talker Echo Loudness Rating)	dB	65
WEPL (Weighted Echo Path Loss)	dB	110
T (Mean Intrinsic One-Way Delay)	msec	0
Ta (Absolute Delay)	msec	0
Tr (Round-Trip Delay)	msec	0
QDU (Quantization Distortion Units)	-	1
Ie (Equipment Impairment Factor)	-	0
A (Expectation Factor)	-	0
Ds (Handset Shape Factor – Send Side)	-	3
Dr (Handset Shape Factor – Receive Side)	-	3
Ps (Room Noise at the Send side)	dB(A)	35
Pr (Room Noise at the Receive side)	dB(A)	35
Nc (Circuit Noise referred to 0 dBr-point)	dBm0p	-70
Nfor (Noise Floor at the Receive Side)	dBmp	-64

Patent Application

Fig. 23

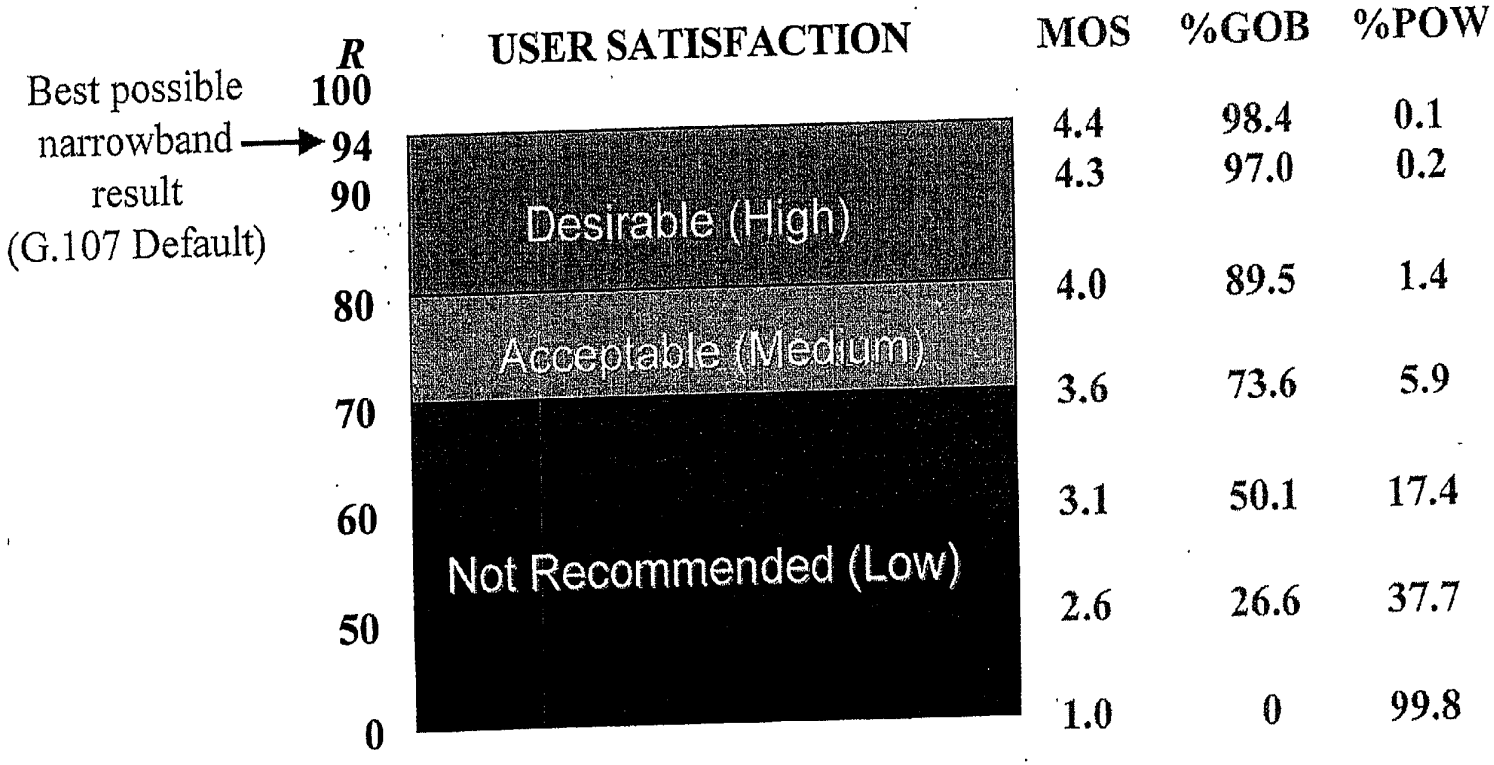


Fig. 24

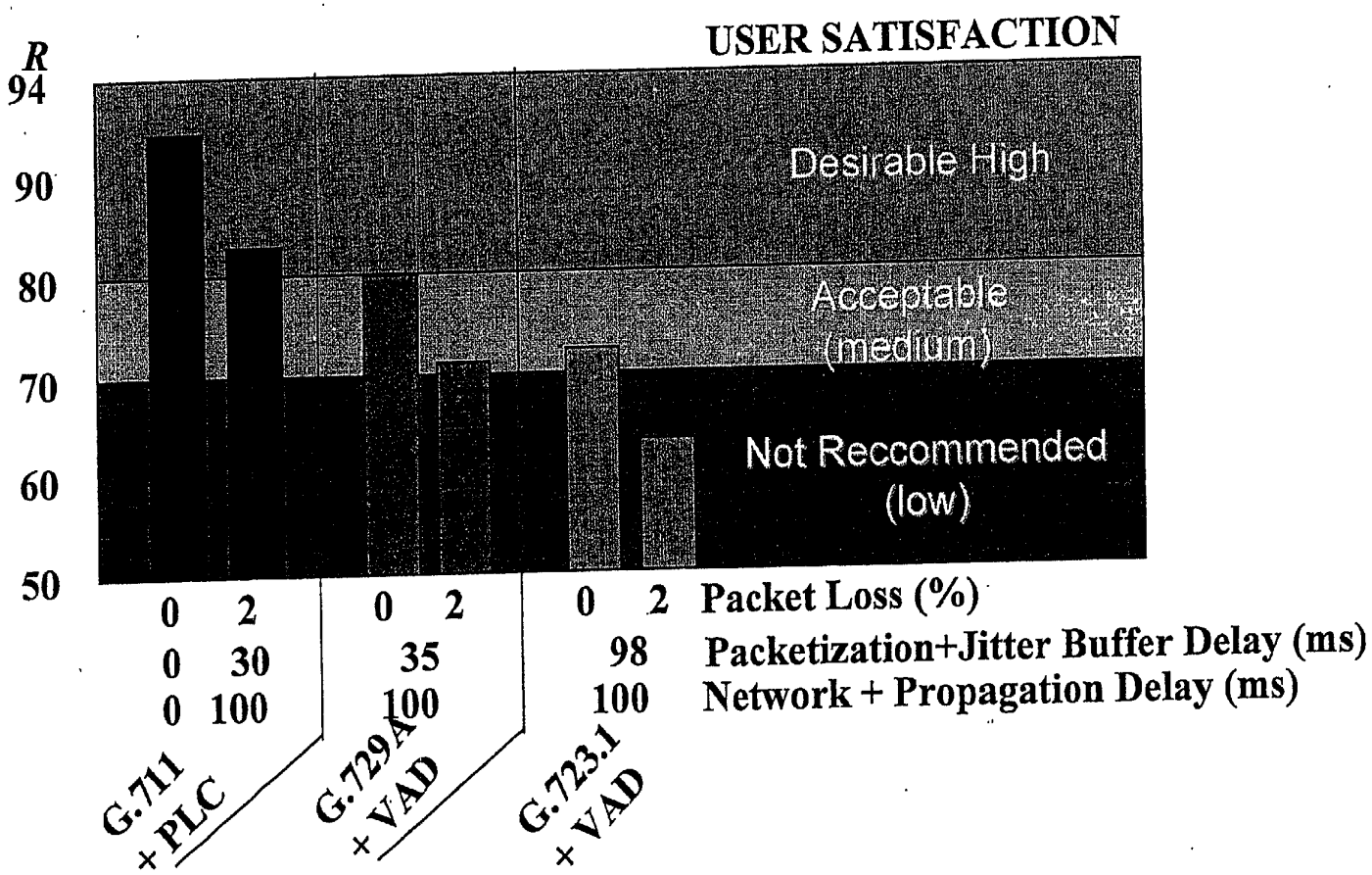

USER SATISFACTION
R
94
90
80
70
60
50
Desirable High
Acceptable (medium)
Not Reccommended (low)
0 2
0 30
0 100
0 2
35
100
0 2
98
100
Packet Loss (%)
Packetization+Jitter Buffer Delay (ms)
Network + Propagation Delay (ms)
G.711 + PLC
G.729A + VAD
G.723.1 + VAD

Fig. 25

Ie for E-Model Calculations

	G.711 [Ref 10] Notes 2, 3]	G.711 [Notes 1, 2, 3]	G.711 [Notes 1, 2, 3]	G.711 [Notes 1, 2, 3, 4]	G.729A [Notes 1, 3]	G.729A [Ref 10] Note 3]	G.729A [Notes 1, 3]	G.729A [Notes 1, 3]	G.726 32kb/s note [5]
Frame Size (ms)	125	125	125	125	10	10	10	10	125
Packet Payload (ms)	10	20	30	40	10	20	30	40	20
Packet Loss (%)									
0	**0**	0	0	0	11	**11**	11	11	7
1	**5**	8	10	13	13	**15**	17	19	**N/A**
2	7	13	16	19	16	**19**	21	24	**N/A**
3	**10**	19	22	24	19	**23**	25	28	**N/A**
4	**12.5***	22	26	28	22	**26**	29	32	**N/A**
5	**15**	25	30	32	25	**29***	32	35	**N/A**

Notes:

1) In the absence of any supporting documentation, these are arbitrary values
2) All G.711 vocoders are assumed to have PLC (Packet Loss Concealment) algorithms
3) Impairment factors apply for random packet loss conditions
4) This is the current capability of the i2004 (in the absence of any download instructions to achieve smaller frame size)
5) There is no PLC algorithm for G.726, therefore its deployment might be limited in lossy network
6) Interpolated values

FOREIGN DOCUMENT

Fig. 26

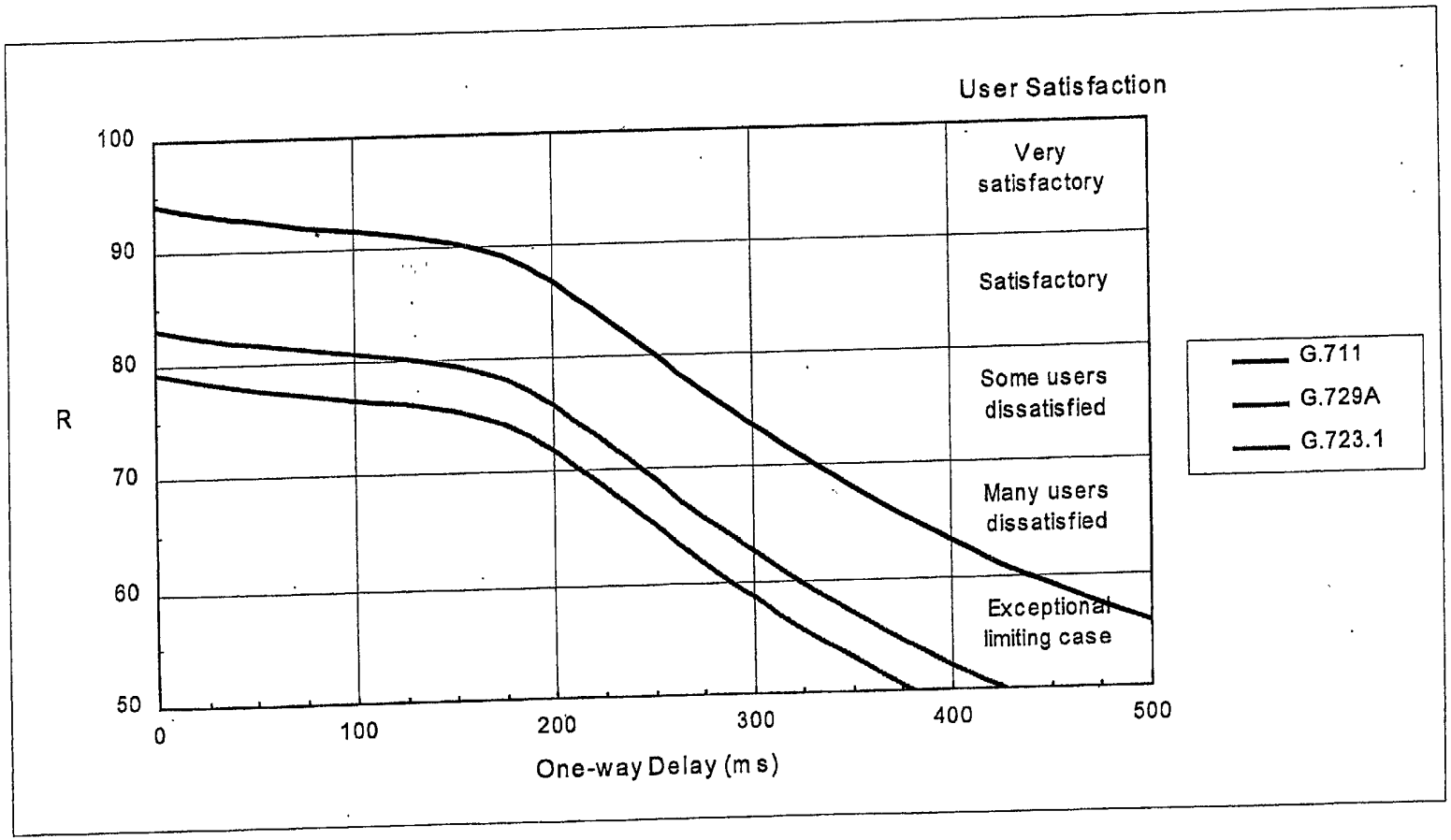
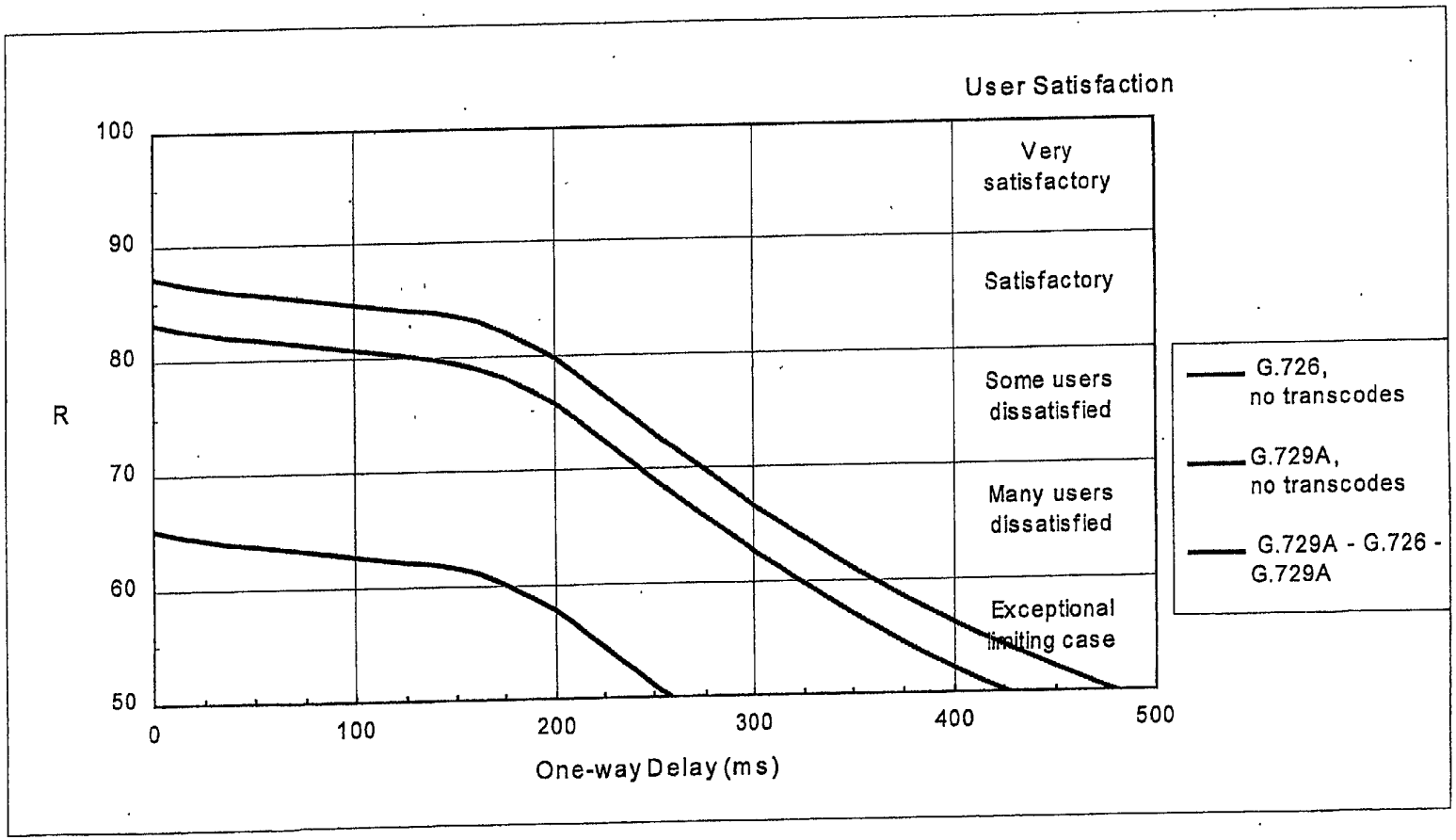


Fig. 27


User Satisfaction
Very satisfactory
Satisfactory
Some users dissatisfied
Many users dissatisfied
Exceptional limiting case
R
100
90
80
70
60
50
0
100
200
300
400
500
One-way Delay (ms)
G.726, no transcodes
G.729A, no transcodes
G.729A - G.726 - G.729A

EUROPEAN PATENT APPLICATION

Fig. 28

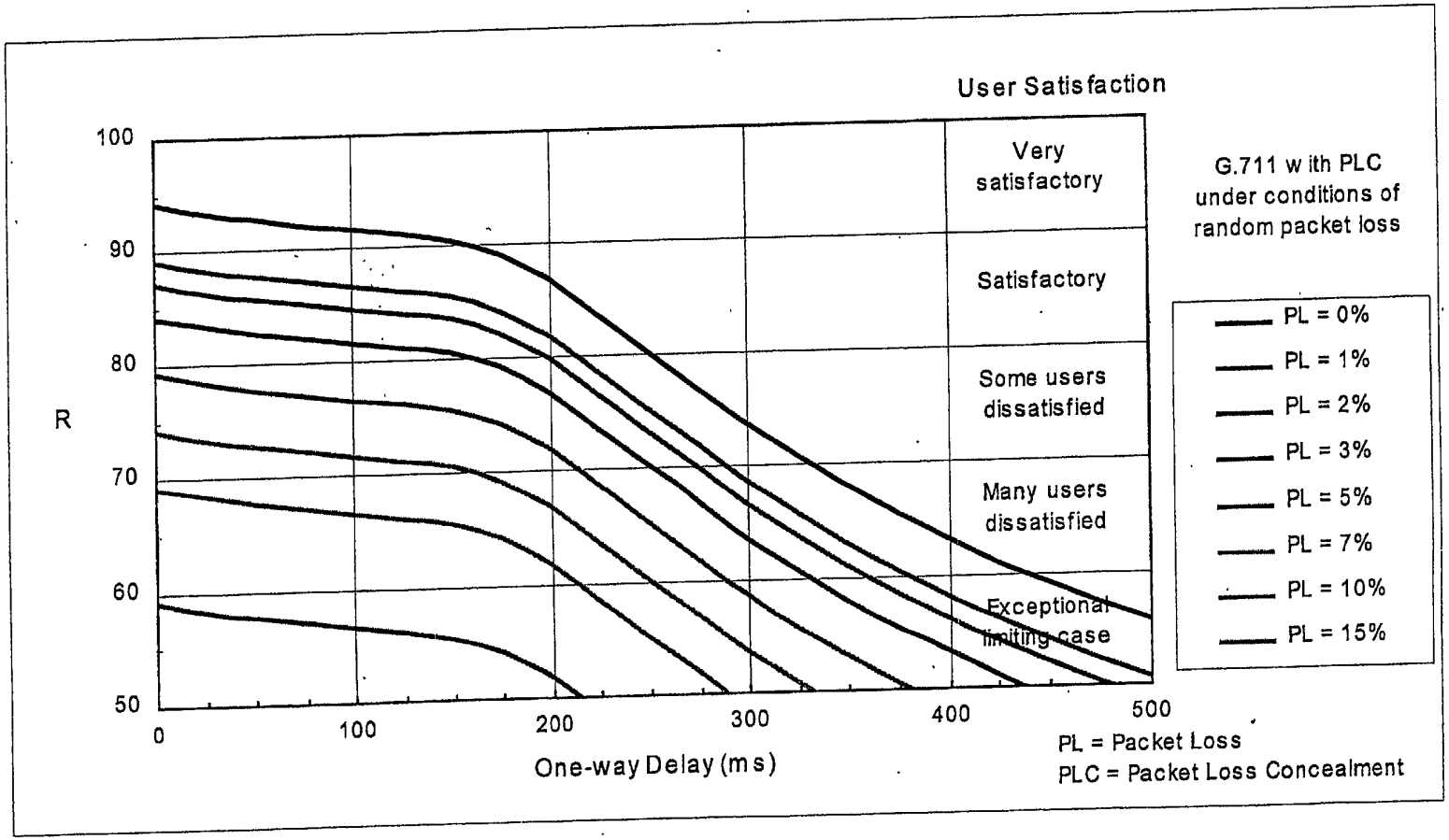
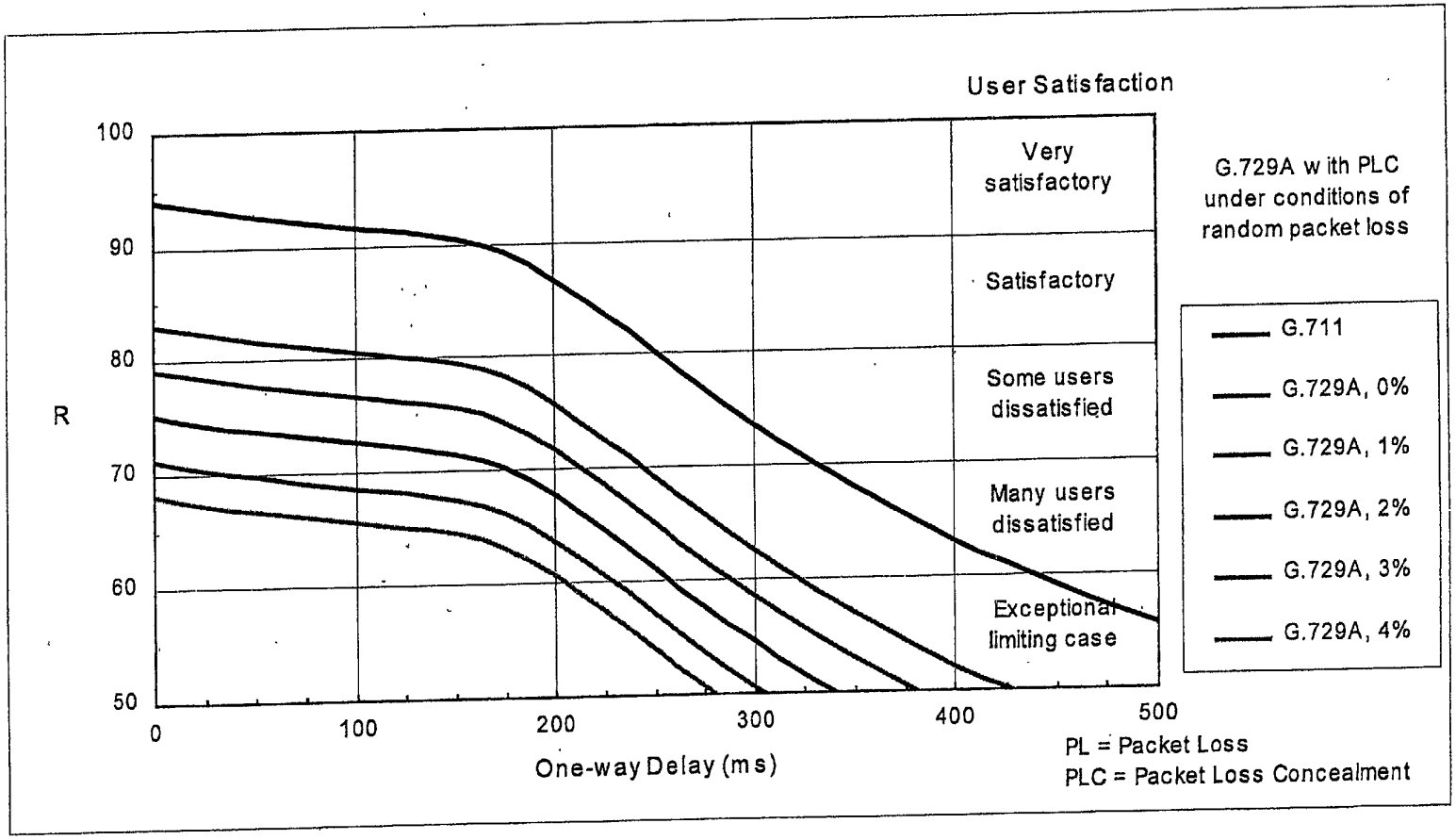
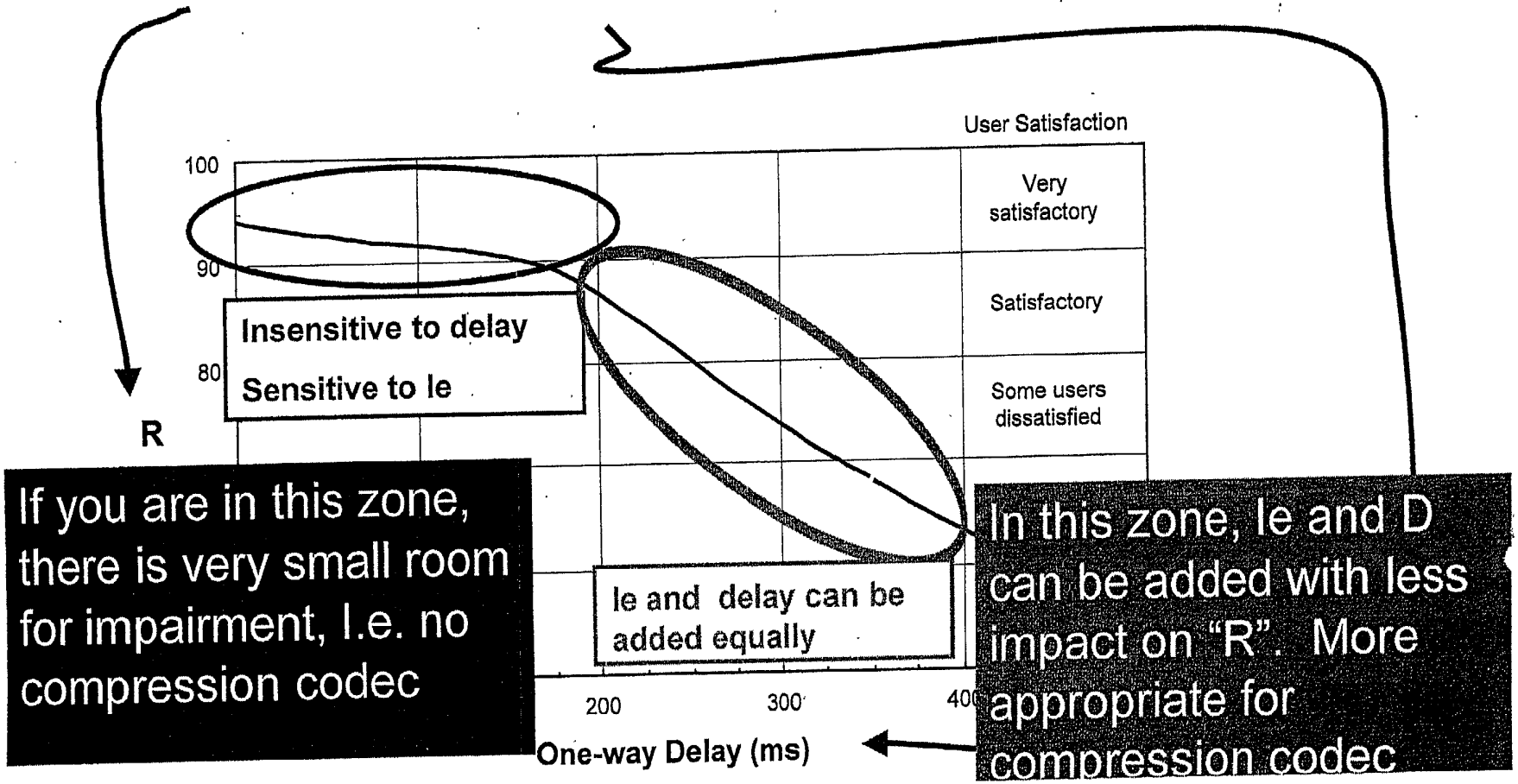


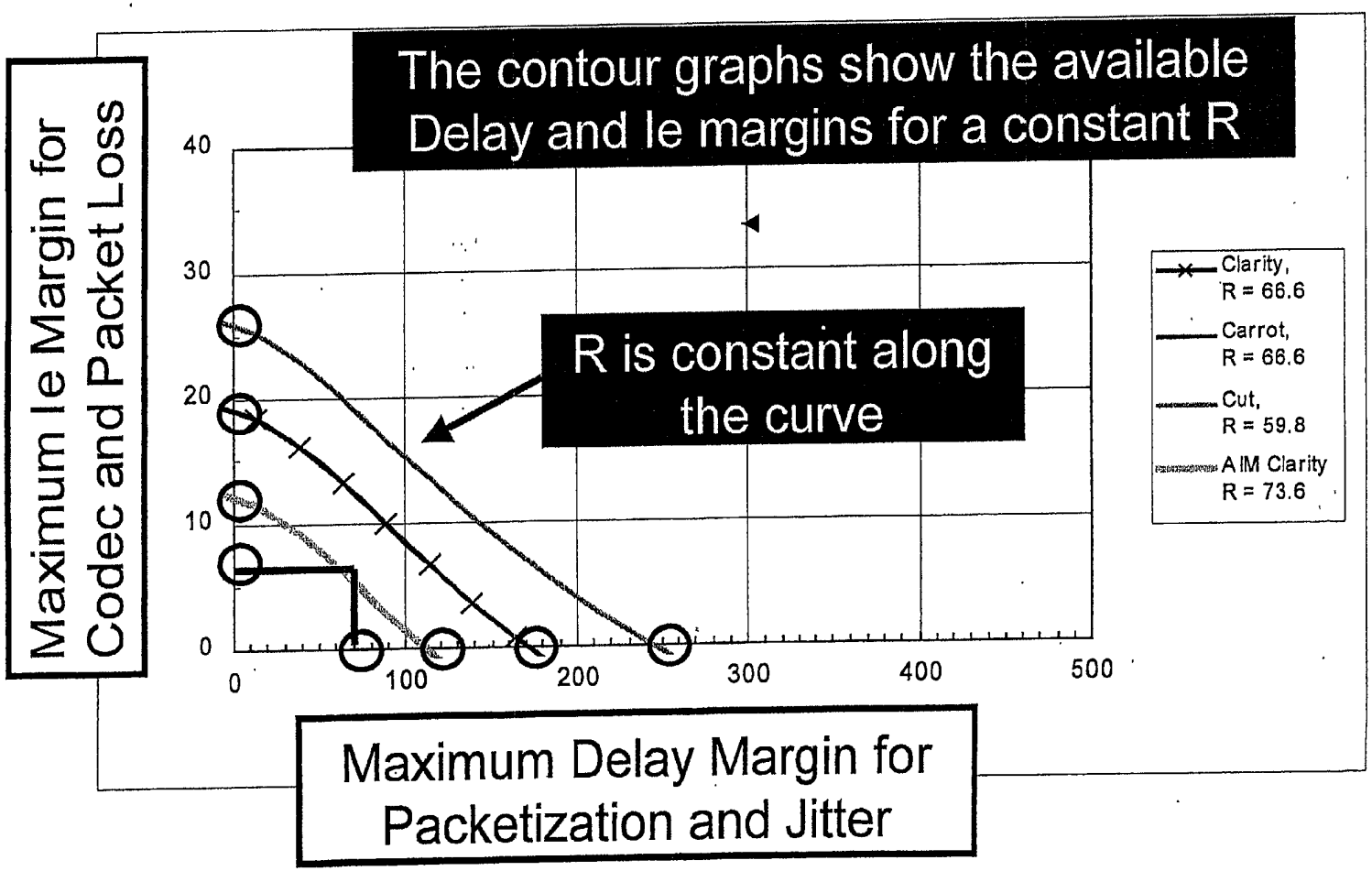
Fig. 29


User Satisfaction
100
90
80
70
60
50
R
0
100
200
300
400
500
One-way Delay (ms)
Very satisfactory
Satisfactory
Some users dissatisfied
Many users dissatisfied
Exceptional limiting case
G.729A with PLC under conditions of random packet loss
G.711
G.729A, 0%
G.729A, 1%
G.729A, 2%
G.729A, 3%
G.729A, 4%
PL = Packet Loss
PLC = Packet Loss Concealment


User Satisfaction
100
90
80
R
Very satisfactory
Satisfactory
Some users dissatisfied
Insensitive to delay
Sensitive to Ie
Ie and delay can be added equally
200
300
400
One-way Delay (ms)
If you are in this zone, there is very small room for impairment, I.e. no compression codec
In this zone, Ie and D can be added with less impact on "R". More appropriate for compression codec

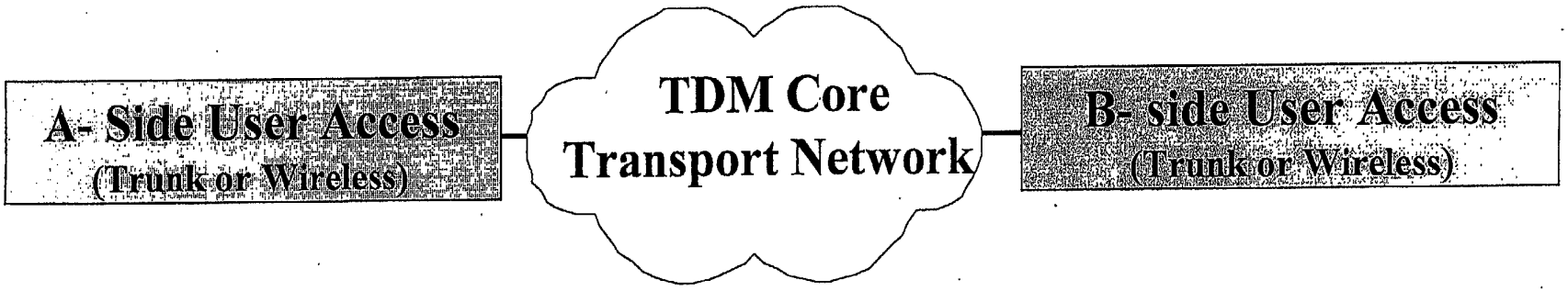
FOSTER DOCKET

Fig. 31



SUBSTITUTE SHEET (RULE 26)

Fig. 32

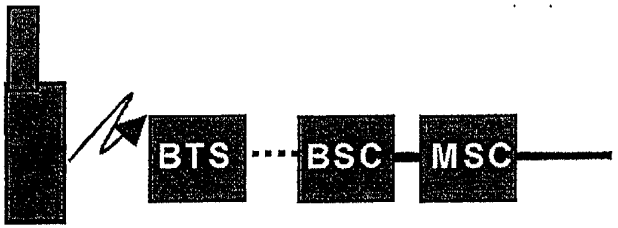


FOSTER 050652CA

Fig. 33

Title	Abbreviation (Default)	E-Model Input
		POTS
Electric Circuit Noise (at 0 dBr)	Nc (-70 dBmP)	
Room Noise	Po (35 dBA)	35
Send Loudness Rating	SLR (8 dB)	11
Receive Loudness Rating	RLR (2 dB)	3
D-factor	D (3)	3
Noise Floor	Nfor (-64 dBm0)	-64
Sidetone Masking Rating	STMR (15)	15
Equipment Impairment Factor	Ie (0)	0
Expectation (Advantage) Factor	A (0)	0
Mean Intrinsic One-Way Delay (upper)	Tu (0 ms)	0
Mean Intrinsic One-Way Delay (lower)	Tl (0 ms)	0
Mean Intrinsic One-Way Delay	Tul (0 ms)	0
Electrical Loss (upper)	Lu (dB)	0
Electrical Loss (lower)	Ll (dB)	0
Electrical Loss (upper = lower)	Lul (dB)	0
Quantizing Distortion Units (upper)	qduu (1) [Note 1]	0
Quantizing Distortion Units (lower)	qdul (1) [Note 1]	0
Echo Return Loss	ERL (dB)	17

Fig. 34



BTS: Base Station
BSC: Base Station Controller
MSC: Mobile Switching Center

PSTN Wireless Access Delay, loss and Impairment Summary		
	Uplink	Downlink
Mobile Switching Center (MSC) (ms)	1	2
Base Station Controller (BSC) (ms)	2.5	40
Base Station (BTS) (ms)	15.8	40.8
Mobile Set (MS) (ms)	72.1	14.3
PSTN Wireless Access Delay (ms)	**91.40**	**97.10**
Impairment Factor (Ie)	**5**	**5**

Fig. 35

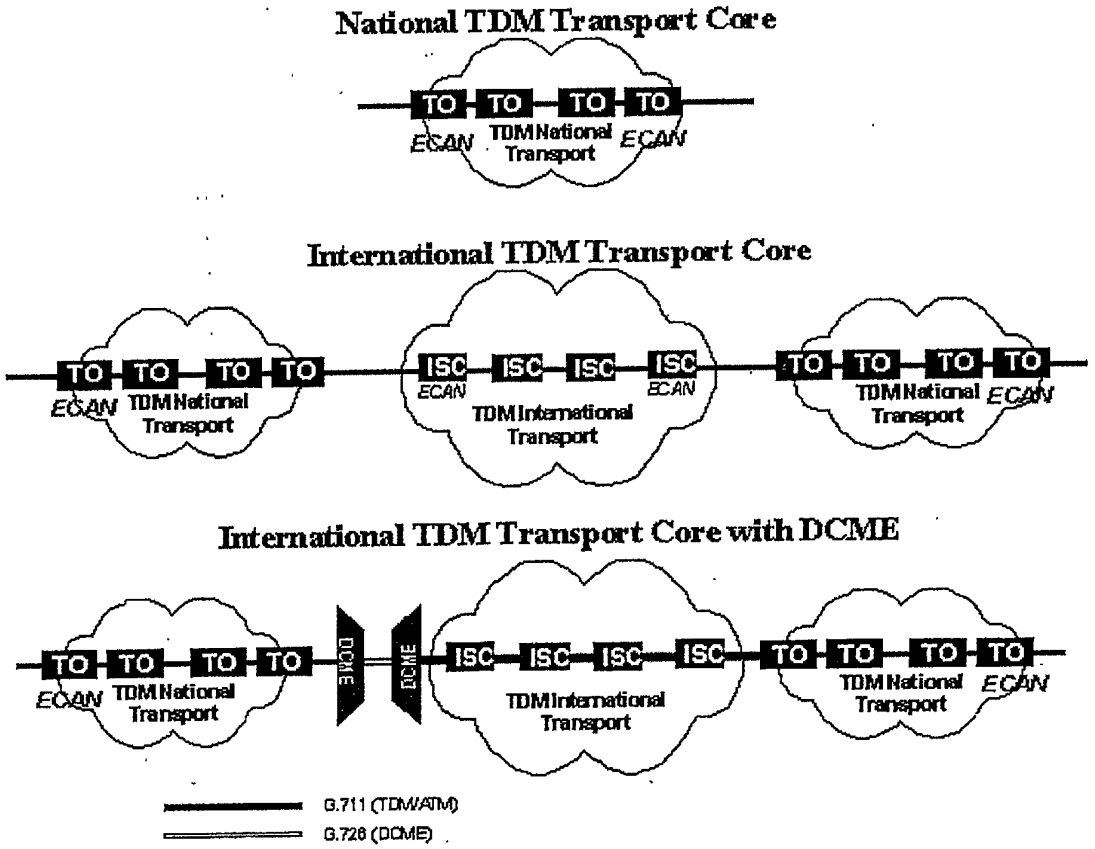

National TDM Transport Core
TO
TO
TO
TO
ECAN
TDM National Transport
ECAN
International TDM Transport Core
TO
TO
TO
TO
ECAN
TDM National Transport
ISC
ISC
ISC
ISC
ECAN
TDM International Transport
ECAN
TO
TO
TO
TO
TDM National Transport
ECAN
International TDM Transport Core with DCME
TO
TO
TO
TO
ECAN
TDM National Transport
DCME
DCME
ISC
ISC
ISC
ISC
TDM International Transport
TO
TO
TO
TO
TDM National Transport
ECAN
G.711 (TDM/ATM)
G.726 (DCME)

Fig. 36

TDM Core Transport	National (8000km)	International (connection Length 27500 km)			
		0 DCME	1 DCME	2 DCME	3 DCME
National Transmission Time	43	43	43	43	43
T2DCME (G.711/G.726 Conversion+DSI) (ms)	-	0	26	52	78
DCME2T (G.726/G.711 Conversion) (ms)	-	0	2	4	6
International Transmission Time (ms	-	72	72	72	72
National Transmission Time	-	43	43	43	43
Total one-way delay (ms)	**43**	**158**	**186**	**214**	**242**
Impairment Factor (Ie)	**0**	**0**	**7**	**14**	**21**

Fig. 37

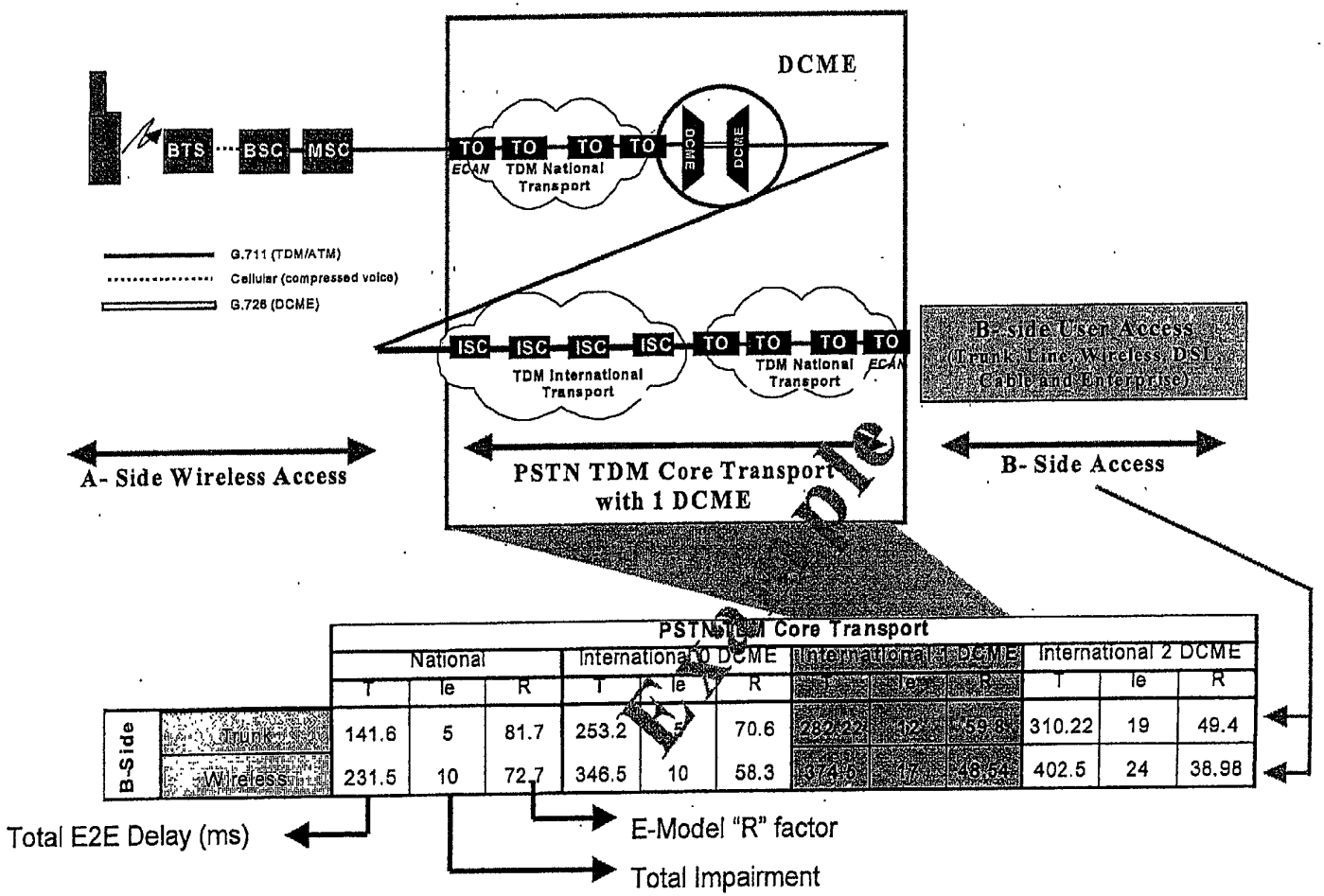
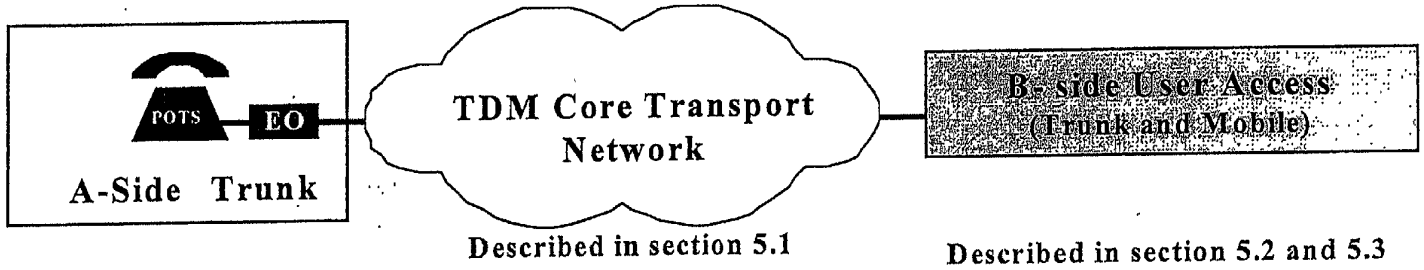
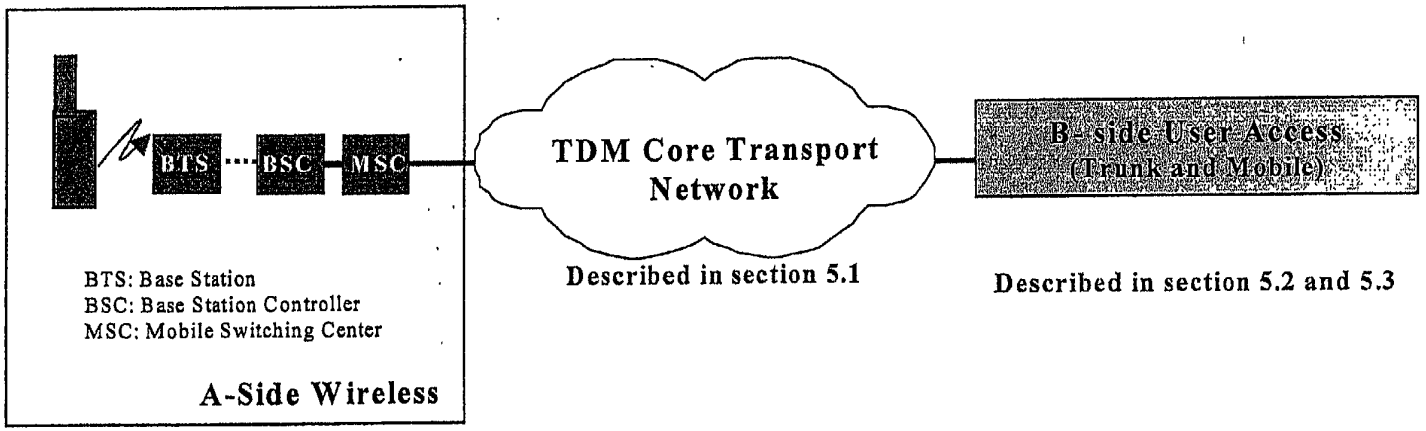

DCME
BTS
BSC
MSC
TO
ECAN
TDM National Transport
DCME
G.711 (TDM/ATM)
Cellular (compressed voice)
G.726 (DCME)
ISC
TDM International Transport
TDM National Transport
B- side User Access (Trunk, Line, Wireless, DSL, Cable and Enterprise)
A- Side Wireless Access
PSTN TDM Core Transport with 1 DCME
B- Side Access
PSTN TDM Core Transport
National
International 0 DCME
International 1 DCME
International 2 DCME
T
Ie
R
B-Side
Trunk
Wireless
141.6
5
81.7
253.2
70.6
310.22
19
49.4
231.5
10
72.7
346.5
10
58.3
402.5
24
38.98
Total E2E Delay (ms)
E-Model "R" factor
Total Impairment

Fig. 38



Trunk Access to	National			International 0 DCME			International 1 DCME			International 2 DCME		
	T	Ie	R	T	Ie	R	T	Ie	R	T	Ie	R
Trunk	46	0	87.8	161.22	0	85.8	190.22	7	76.8	218.22	14	66.6
Wireless	139.24	5	81.7	253.22	5	70.6	282.22	12	59.8	310.22	19	49.4

Fig. 39



Wireless Access to	National			International 0 DCME			International 1 DCME			International 2 DCME		
	T	Ie	R	T	Ie	R	T	Ie	R	T	Ie	R
Trunk	141.6	5	81.7	253.2	5	70.6	282.22	12	59.8	310.22	19	49.4
Wireless	231.5	10	72.7	346.5	10	58.3	374.5	17	48.54	402.5	24	38.98

Fig. 40

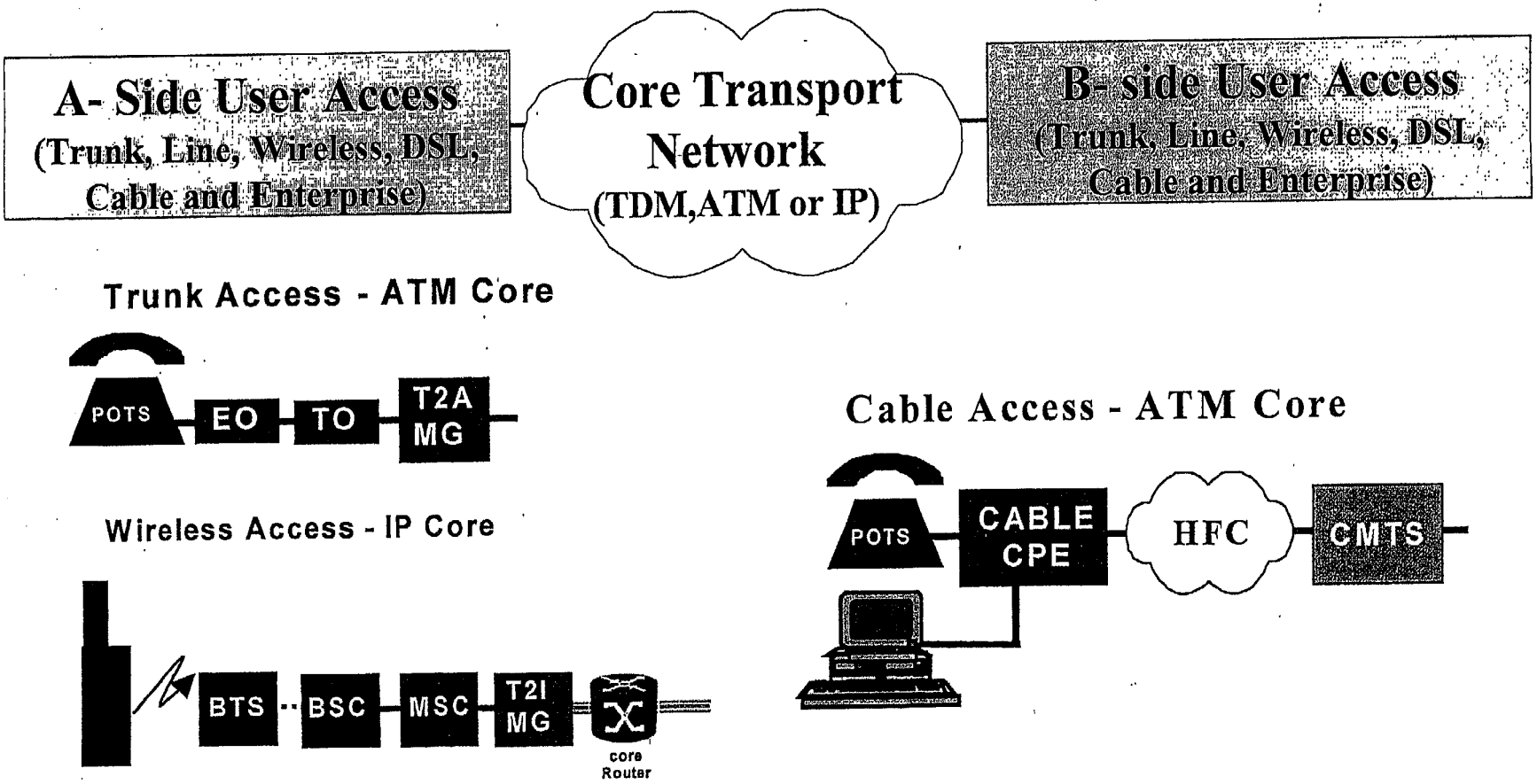
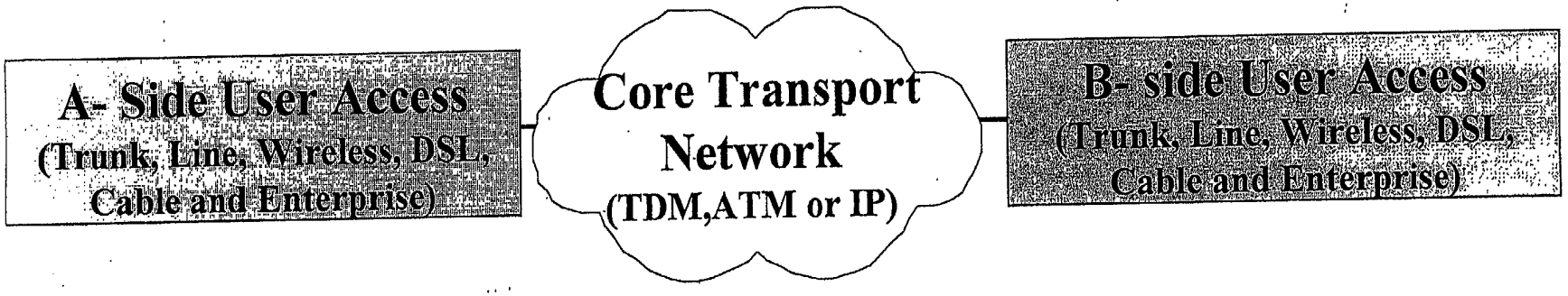
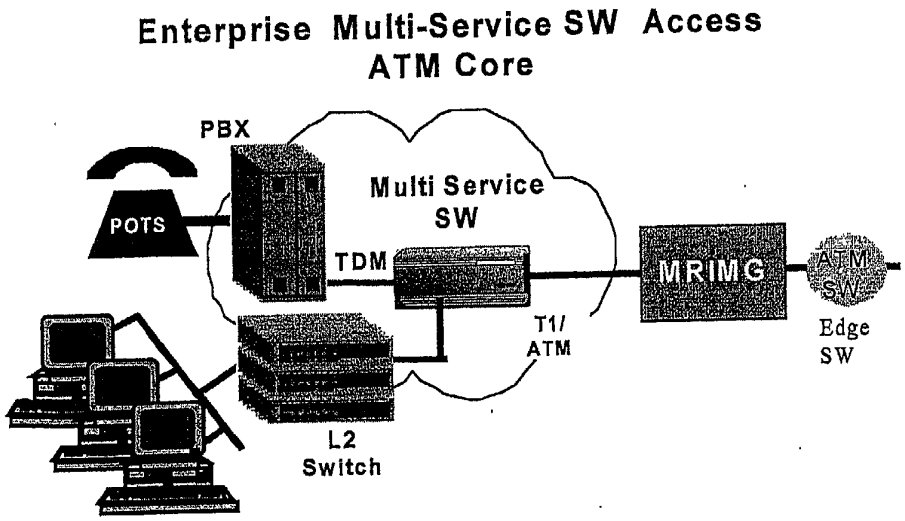

A- Side User Access
(Trunk, Line, Wireless, DSL, Cable and Enterprise)
Core Transport Network
(TDM,ATM or IP)
B- side User Access
(Trunk, Line, Wireless, DSL, Cable and Enterprise)
Trunk Access - ATM Core
POTS
EO
TO
T2A MG
Wireless Access - IP Core
BTS
BSC
MSC
T2I MG
core Router
Cable Access - ATM Core
POTS
CABLE CPE
HFC
CMTS

Fig. 41


A- Side User Access
(Trunk, Line, Wireless, DSL, Cable and Enterprise)
Core Transport Network
(TDM,ATM or IP)
B- side User Access
(Trunk, Line, Wireless, DSL, Cable and Enterprise)


Enterprise Multi-Service SW Access
ATM Core
PBX
POTS
Multi Service SW
TDM
T1/ ATM
MRIMG
ATM SW
Edge SW
L2 Switch

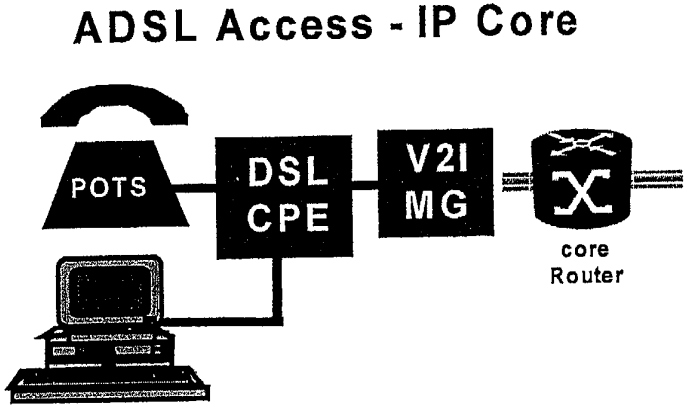

ADSL Access - IP Core
POTS
DSL CPE
V2I MG
core Router

Fig. 42

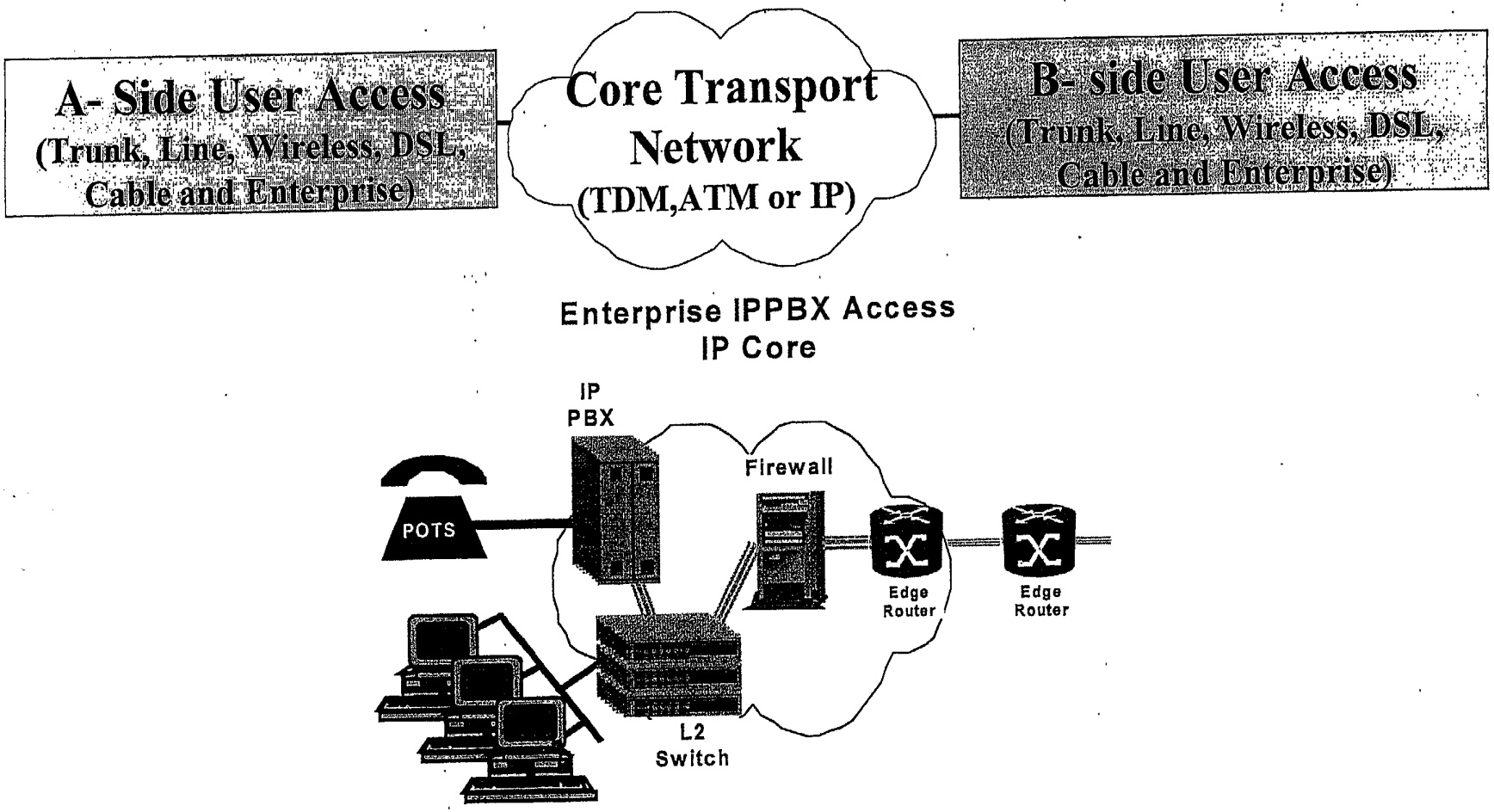

A- Side User Access
(Trunk, Line, Wireless, DSL, Cable and Enterprise)
Core Transport Network
(TDM,ATM or IP)
B- side User Access
(Trunk, Line, Wireless, DSL, Cable and Enterprise)
Enterprise IPPBX Access
IP Core
IP
PBX
POTS
Firewall
Edge
Router
Edge
Router
L2
Switch

Fig. 43

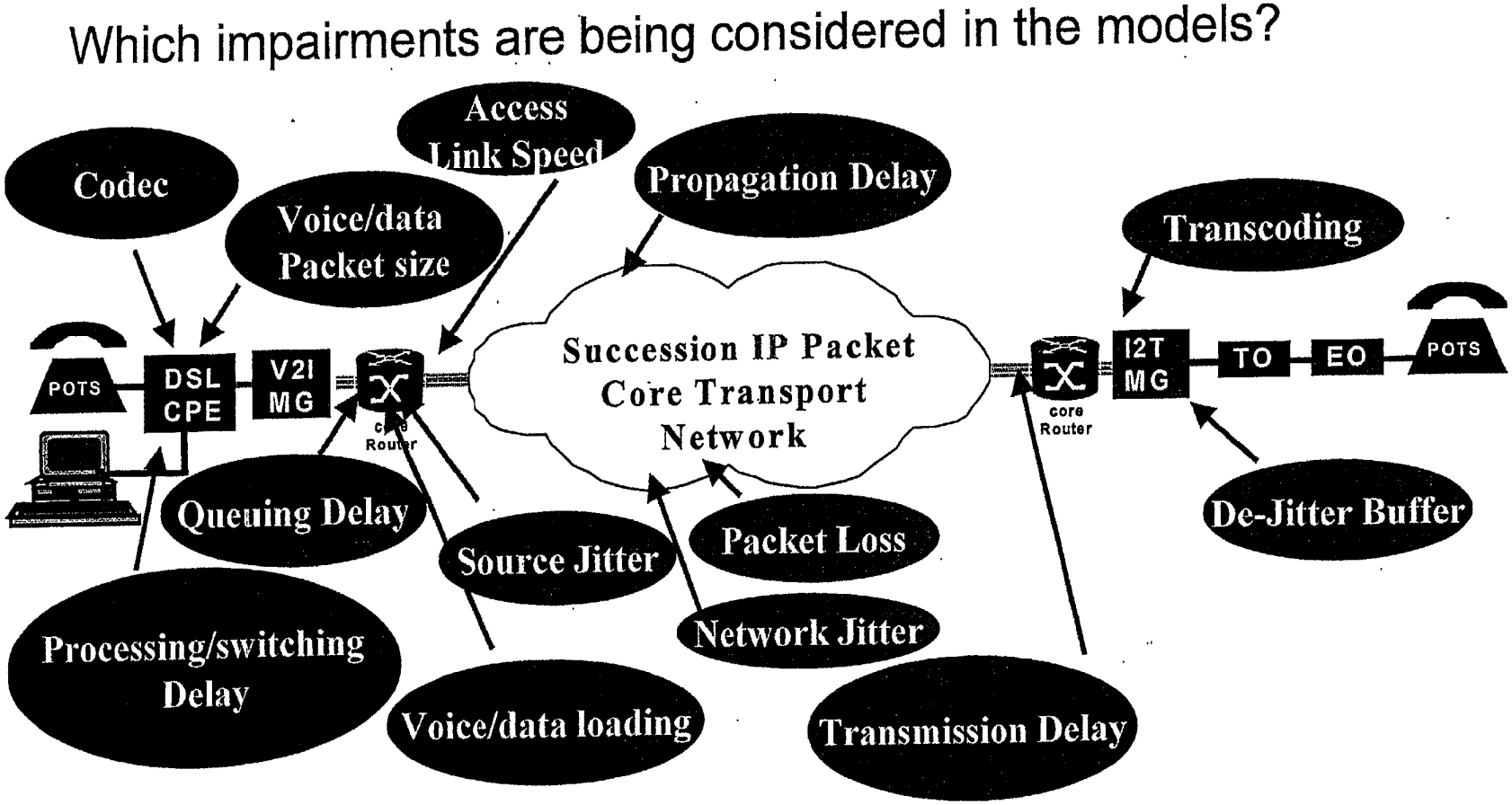

Which impairments are being considered in the models?
Access Link Speed
Codec
Voice/data Packet size
Propagation Delay
Transcoding
POTS
DSL CPE
V2I MG
Succession IP Packet Core Transport Network
I2T MG
TO
EO
POTS
core Router
Queuing Delay
Source Jitter
Packet Loss
De-Jitter Buffer
Processing/switching Delay
Network Jitter
Voice/data loading
Transmission Delay

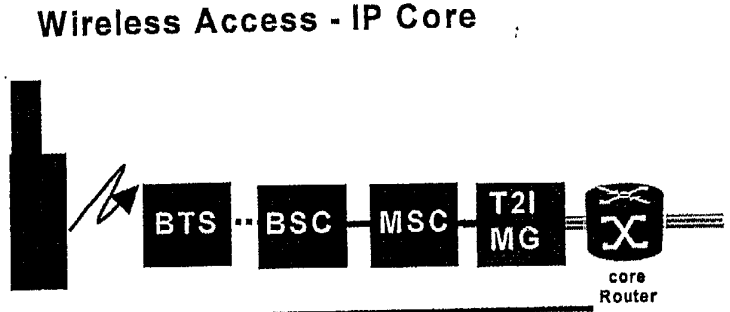
Fig. 44

Trunk Access - ATM Core

Trunk Access to ATM Core - (before 4 parameters budget assignment) Delays, loss and Impairment Summary	
Set delay (Side A) (ms) End Office Delay (Side A) (ms) Tandem Office Delay (Side A) (ms) T2AMG delay (Side A) (ms)	0 1.5 0.75 0.5
Trunk Access delay (ms) **Impairment Factor (Ie)**	**2.75** **0**

PUBLIC DOCUMENT

Fig. 45



Succesion Wireless to ATM Core - Delay, loss ad Impairment Summary (before 4 parameters budget assignment)		
	Uplink	Downlink
Mobile Switching Center (MSC) (ms)	1	2
Base Station Controller (BSC) (ms)	2.5	40
Base Station (BTS) (ms)	15.8	40.8
Mobile Set (MS) (ms)	72.1	14.3
T2AMG delay (Side A) (ms)	0.5	0.5
Wireless Access delay (ms)	**91.40**	**97.10**
Impairment Factor (Ie)	**5**	**5**

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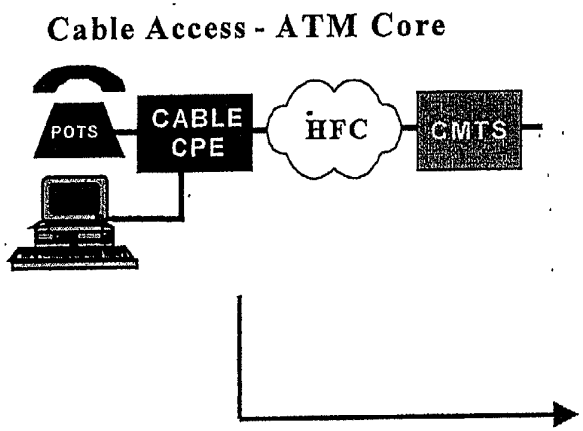
Fig. 46



Cable CPE	Cable CPE Upstream	Cable CPE Downstream	Note
Link Speed	**510 Kbps**	**3000 Kbps**	note [1]
Voice packet size (byte)	160	160	note [2]
Voice packet overhead (RTP/UDP/IP)	48	48	
Data packet size (byte)	512	512	
Data packet overhead	48	48	
Voice packet link utilization (%)	10.0%	10.0%	
Data packet link utilization (%)	90.0%	90.0%	
Fixed Delay			
- Serialization delay for voice packet (ms)	3.26	0.55	note [3]
- DSP & CPU processing delay (ms)	12.00	14.00	note [4]
- Packetization Delay (ms)	0.00	N/A	note [5]
Variable Delay			
- Average Voice data contention (ms)	4.57	0.78	note [6]
- Maximum Voice data contention (ms)	9.15	1.55	note [6]
- De-Jitter buffer delay (ms)	N/A	0.00	note [5]
Other Impairments			
- Packet Loss (%)	**0.00**	**0.00**	note [5]
Minimum Delay (Fixed Delays) (ms)	**15.26**	**14.55**	
Average Delay (Fixed+Average Variable Delays) (ms)	19.84	15.33	
Maximum Delay (Fixed+ Max Variable Delays) (ms)	24.41	16.11	

Fig. 47

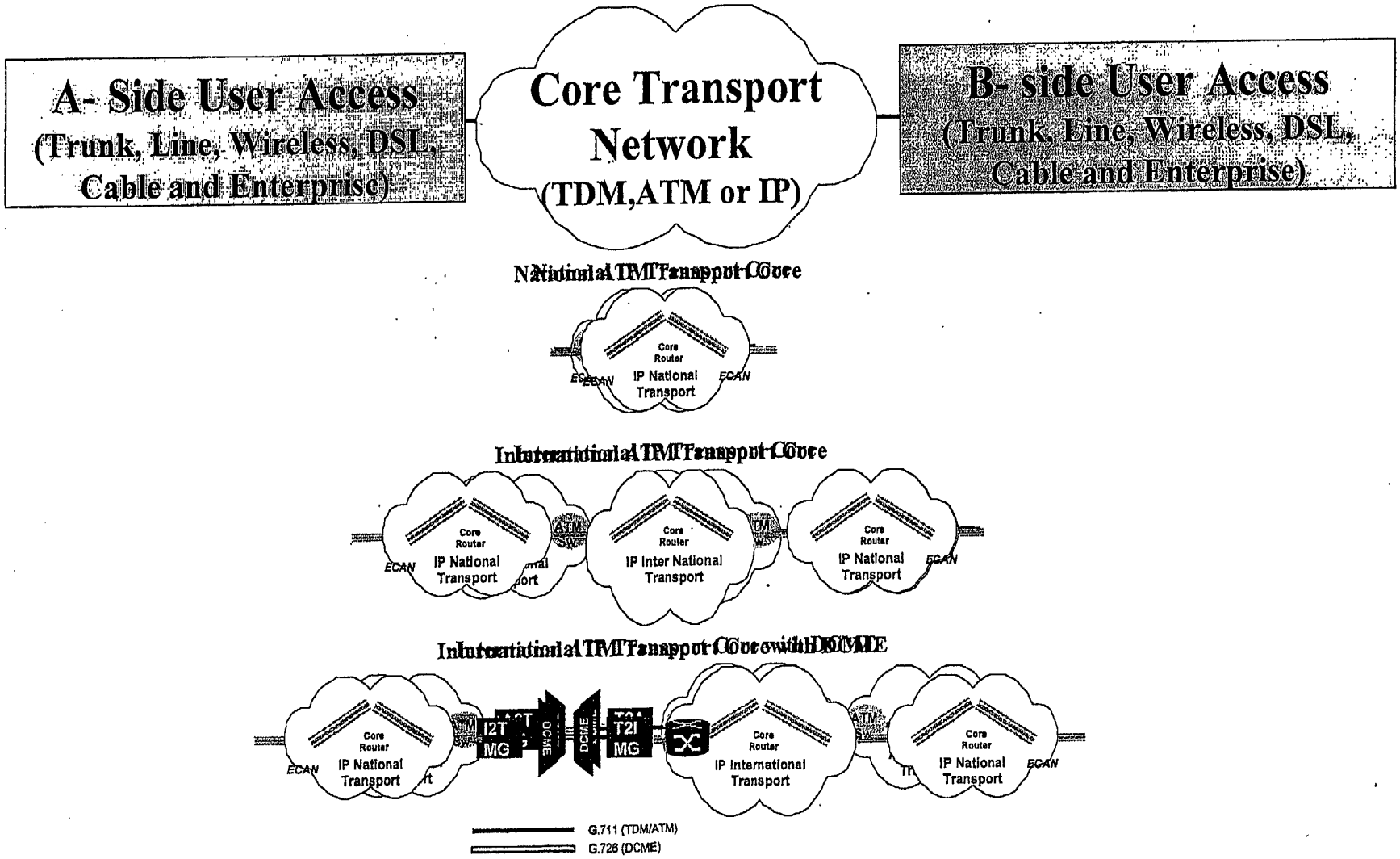
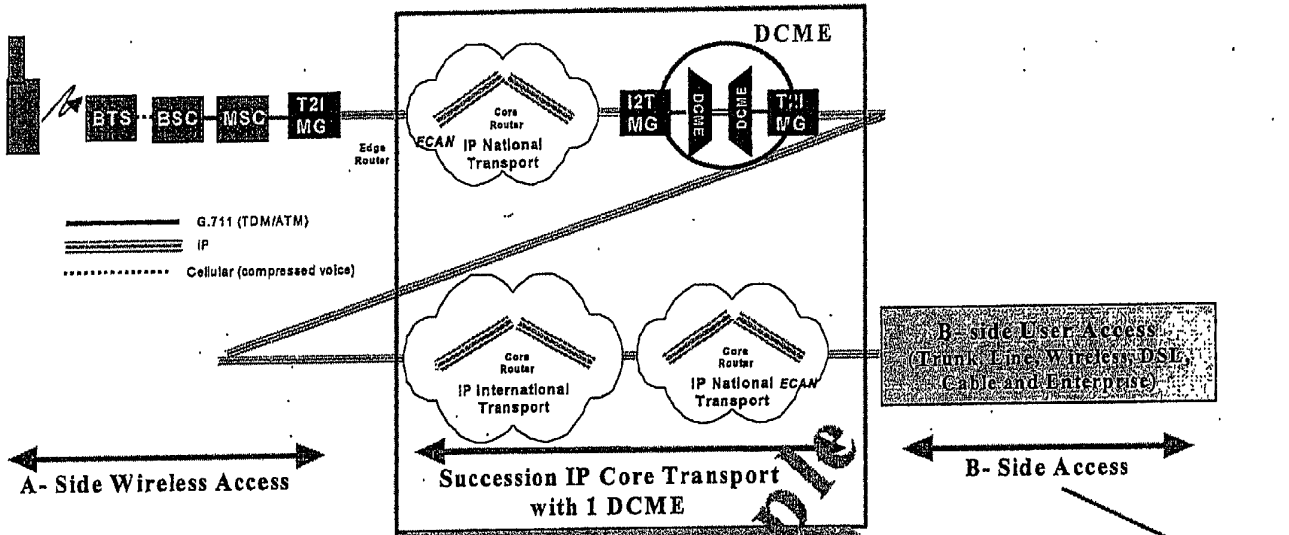

A- Side User Access
(Trunk, Line, Wireless, DSL, Cable and Enterprise)
Core Transport Network
(TDM,ATM or IP)
B- side User Access
(Trunk, Line, Wireless, DSL, Cable and Enterprise)
National ATM Transport Core
Core Router
IP National Transport
ECAN
International ATM Transport Core
IP Inter National Transport
IP National Transport
International ATM Transport Core with DCME
I2T MG
DCME
T2I MG
IP International Transport
G.711 (TDM/ATM)
G.726 (DCME)

Fig. 48

Total National Transport Distance (km)	8000 km (IP)	8000 km (ATM)	8000 km (TDM)	Note:
Terrestrial Distance (km)	8000	8000	8000	
Terrestrial propagation Delay @ 5us / km (ms)	40	40	40	From G.114
Submarine Distance (km)	-	-	-	
Submarine propagation Delay @ 6us / km (ms)	-	-	-	From G.114
Number of hop	5	8	4	From I.356, TIA IS-810 G.114
Equipment processing time (ms)	1ms x 5	0.03ms x 8	0.75ms x 4	
Jitter (ms)	note [1]	1.5 note [3]	0	I.356 QoS class 1
Total Delay (ms)	45	41.74	43	Note [2]

International Core Transport delay	27500 (IP)	27500 (ATM)	27500 (TDM)	Note
Terrestrial Distance (km)	16000	16000	16000	
Terrestrial Delay @ 5us / km (ms)	80	80	80	
Number of hop	15	19	12	From I.356, TIA IS-810
Equipment processing time per hop	1	0.03	0.75	G.114
Equipment processing time (ms)	15	0.57	9	G.115
Submarine Distance (km)	11500	11500	11500	
Submarine Delay @ 6us / km (ms)	69	69	69	
Jitter (ms)	note [1]	3	0	I.356 QoS class 1
Total Delay (ms)	**164**	**149.57**	**158**	**Note [2]**

Fig. 49



		Succesion IP Core Transport											
		National			International 0 DCME			International 1 DCME			International 2 DCME		
		T	Ie	R	T	Ie	R	T	Ie	R	T	Ie	R
B-Side Access	Trunk	145	5	82	264	5	69	293	12	69	321	19	48
	Line	142	5	82	261	5	70	290	12	69	318	19	48
	Wireless	237	10	72	356	10	57	385	17	48	413	24	38
	VoDSL	164	5	81	283	5	67	312	12	66	340	19	46
	Cable	158	5	81	277	5	67	306	12	67	334	19	47
	Enterprise MSS	156	5	81	275	5	68	304	12	67	332	19	47
	Enterprise PBX	172	5	80	291	5	66	320	12	65	348	19	45

Intrinsic R-factor (before parameter budget assuagement)

Total end-to-end intrinsic impairment (before parameter budget assuagement)

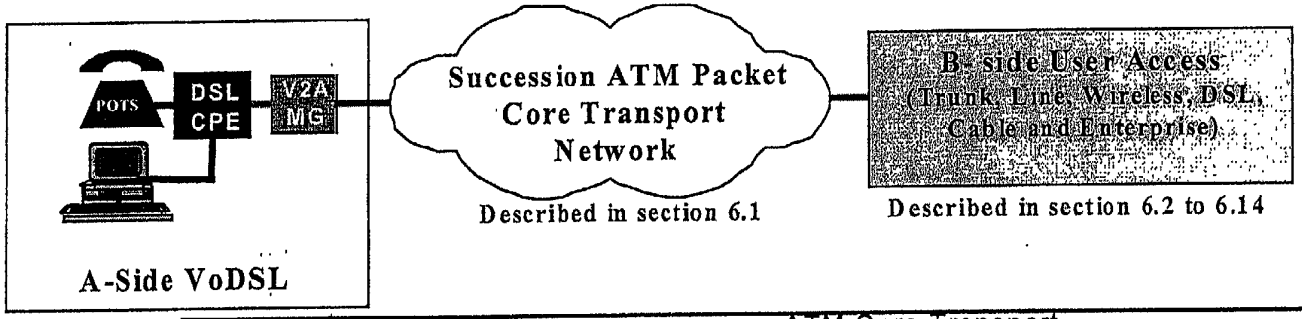
Total end-to-end intrinsic delay (before parameter budget assuagement)

Fig. 50

B-Side Access	ATM Core Transport											
	National			International 0 DCME			International 1 DCME			International 2 DCME		
	I	Ie	R	I	Ie	R	I	Ie	R	I	Ie	R
POTS Trunk	47	0	88	161	0	86	190	7	77	218	14	67
POTS Line	45	0	88	159	0	86	188	7	77	216	14	67
Wireless	139	5	82	253	5	71	282	12	60	310	19	49
VoDSL	66	0	87	180	0	85	209	7	75	237	14	64
MV Cable	61	0	88	175	0	85	204	7	75	232	14	65
Enterprise MSS	48	0	88	162	0	86	191	7	77	219	14	67
Enterprise IP PBX	64	0	88	178	0	85	207	7	75	235	14	64

Note: The four parameters: packetization delay, delay jitter, codec and packet loss have been set to zero. Those four parameters will be determined based upon the available margin. The margin is determined based on the benchmark comparison of an end-to-end Succession network with the closest benchmark representation of existing networks (PSTN only, mobile to PSTN, or mobile to mobile).

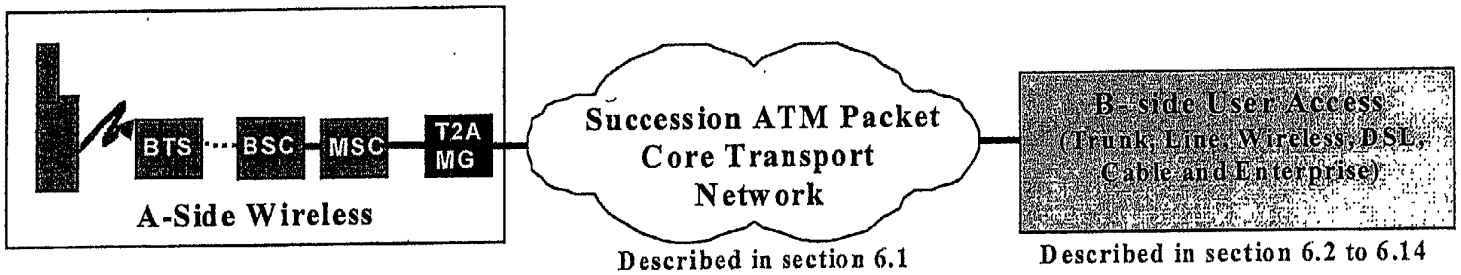
Fig. 51



B-Side Access	ATM Core Transport											
	National			International 0 DCME			International 1 DCME			International 2 DCME		
	I	Ie	R	I	Ie	R	I	Ie	R	I	Ie	R
POTS Trunk	66	0	87	180	0	85	209	7	75	237	14	64
POTS Line	64	0	88	178	0	85	207	7	75	235	14	64
Wireless	158	5	81	272	5	68	301	12	57	329	19	47
VoDSL	86	0	87	200	0	83	229	7	72	257	14	62
Cable	80	0	87	194	0	83	223	7	73	251	14	62
Enterprise MSS	67	0	87	181	0	85	210	7	75	238	14	64
Enterprise IP-PBX	84	0	87	198	0	83	227	7	73	255	14	62

Note: The four parameters: packetization delay, delay jitter, codec and packet loss have been set to zero. Those four parameters will be determined based upon the available margin. The margin is determined based on the benchmark comparison of an end-to-end Succession network with the closest benchmark representation of existing networks (PSTN only, mobile to PSTN, or mobile to mobile).

Fig. 52



B-Side Access	IP Core Transport											
	National			International 0 DCME			International 1 DCME			International 2 DCME		
	I	Ie	R	I	Ie	R	I	Ie	R	I	Ie	R
POTS Trunk	145	5	86	264	5	74	293	12	63	321	19	53
POTS Line	142	5	86	261	5	74	290	12	64	318	19	53
Wireless	237	10	72	356	10	57	385	17	48	413	24	38
VoDSL	164	5	85	283	5	71	312	12	61	340	19	51
Cable	158	5	85	277	5	72	306	12	62	334	19	52
Enterprise MSS	156	5	85	275	5	72	304	12	62	332	19	52
Enterprise IP PBX	172	5	84	291	5	70	320	12	60	348	19	50

Note: The four parameters: packetization delay, delay jitter, codec and packet loss have been set to zero. Those four parameters will be determined based upon the available margin. The margin is determined based on the benchmark comparison of an end-to-end Succession network with the closest benchmark representation of existing networks (PSTN only, mobile to PSTN, or mobile to mobile).

Fig. 53

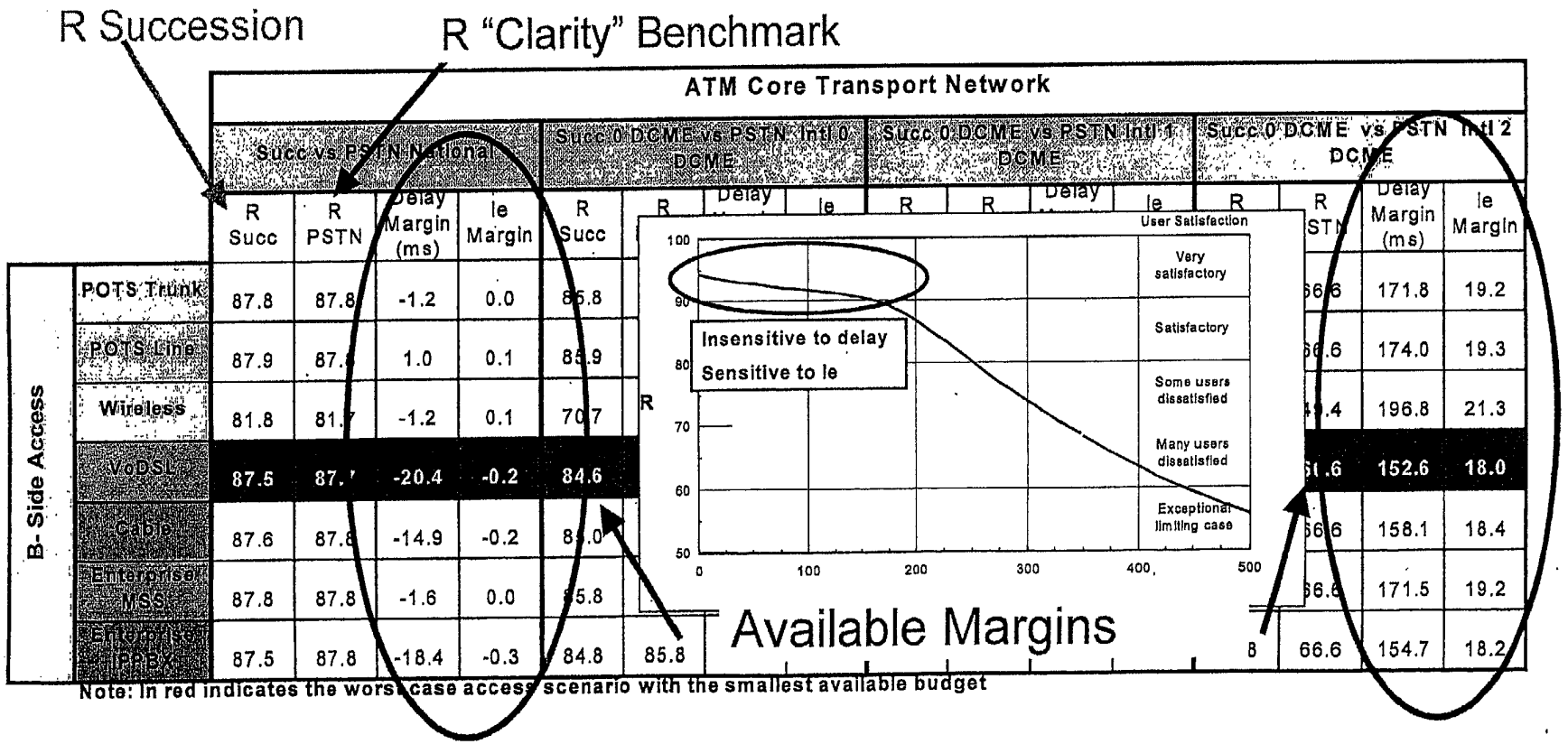
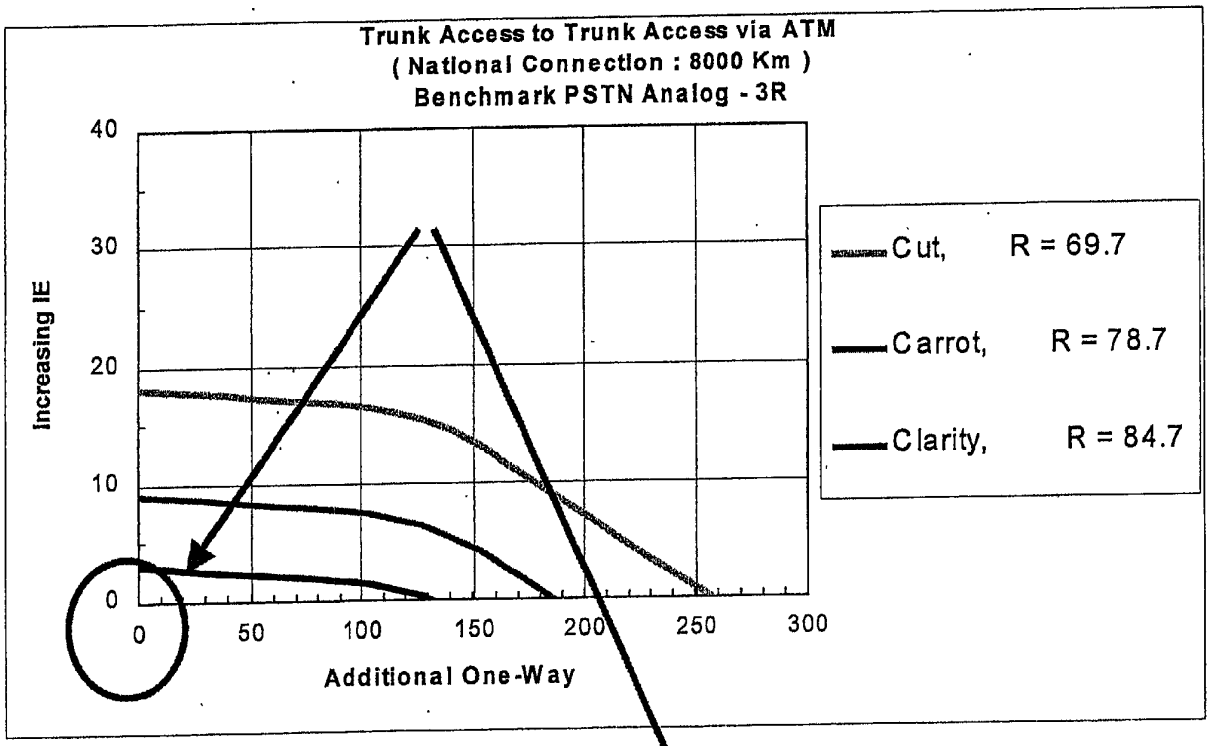
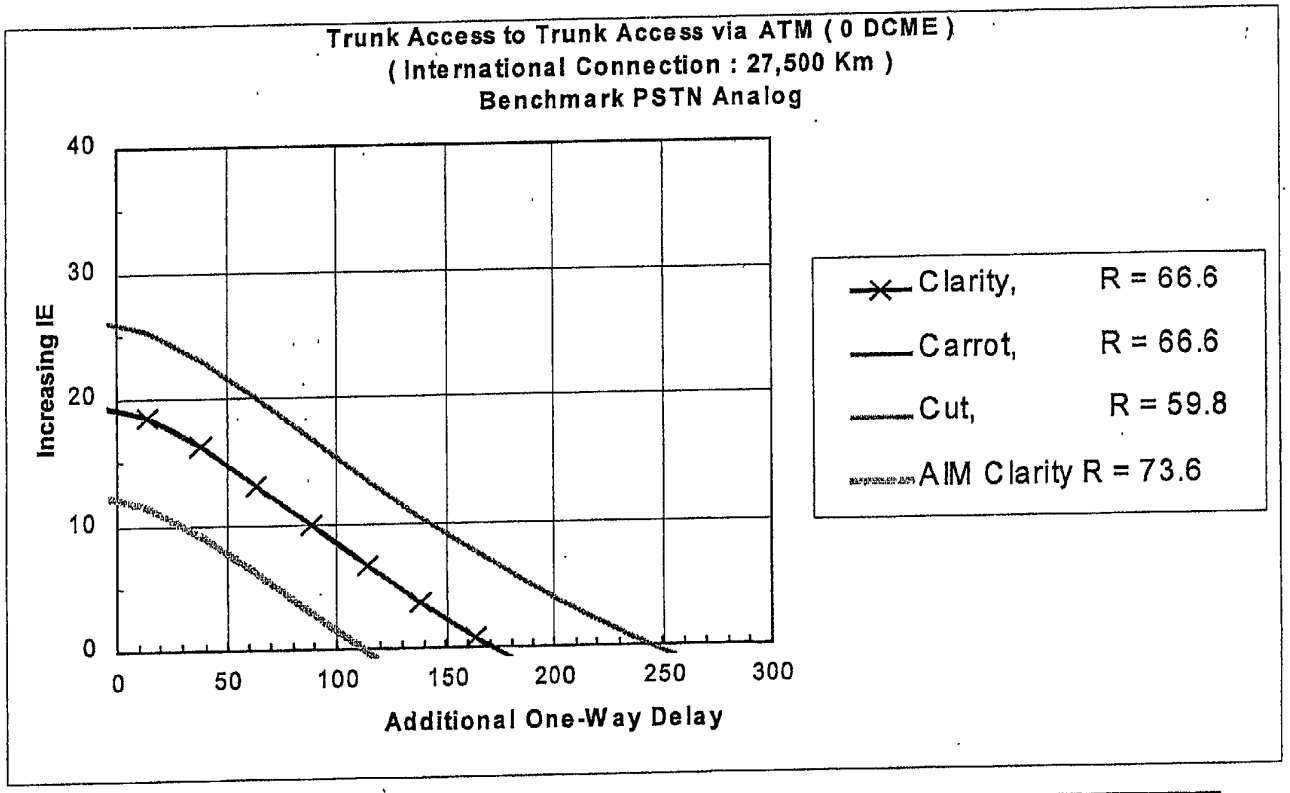

R Succession
R "Clarity" Benchmark
ATM Core Transport Network
Succ vs PSTN National
Succ 0 DCME vs PSTN Intl 0 DCME
Succ 0 DCME vs PSTN Intl 1 DCME
Succ 0 DCME vs PSTN Intl 2 DCME
R Succ
R PSTN
Delay Margin (ms)
Ie Margin
B- Side Access
POTS Trunk
POTS Line
Wireless
VoDSL
Cable
Enterprise MSS
Enterprise IP PBX
87.8 87.8 -1.2 0.0
87.9 87.6 1.0 0.1
81.8 81.7 -1.2 0.1
87.5 87.1 -20.4 -0.2 84.6
87.6 87.8 -14.9 -0.2
87.8 87.8 -1.6 0.0
87.5 87.8 -18.4 -0.3 84.8 85.8
171.8 19.2
174.0 19.3
196.8 21.3
152.6 18.0
158.1 18.4
171.5 19.2
154.7 18.2
User Satisfaction
Very satisfactory
Satisfactory
Some users dissatisfied
Many users dissatisfied
Exceptional limiting case
Insensitive to delay
Sensitive to Ie
R
Ie
Available Margins
Note: In red indicates the worst case access scenario with the smallest available budget

Fig. 54



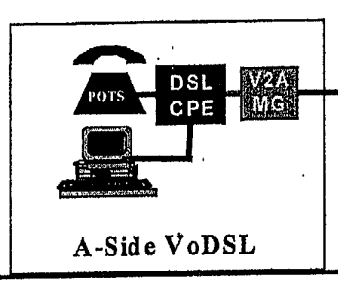
Ie Budget =	3	9	18
Delay Budget =	130	186	257

Fig. 55



Ie Budget =	12.07	19.07	19.07	25.87
Delay Budge	110.9	171.5	171.5	244.4

Fig. 56



Succession ATM Packet Core Transport Network

Described in section 6.1

B- side User Access (Trunk, Line, Wireless, DSL, Cable and Enterprise)

Described in section 6.2 to 6.14

ATM Core Transport Network

B-Side Access	Succ vs PSTN National				Succ 0 DCME vs PSTN Intl 0 DCME				Succ 0 DCME vs PSTN Intl 1 DCME				Succ 0 DCME vs PSTN Intl 2 DCME			
	R Succ	R PSTN	Delay Margin (ms)	Ie Margin	R Succ	R PSTN	Delay Margin (ms)	Ie Margin	R Succ	R PSTN	Delay Margin (ms)	Ie Margin	R Succ	R PSTN	Delay Margin (ms)	Ie Margin
POTS Trunk	87.5	87.8	-20										84.6	66.6	152.6	18.0
POTS Line	87.5	87.8	-18										84.8	66.6	154.8	18.2
Wireless	81.2	81.7	-20										68.1	49.4	177.6	18.7
VoDSL	87.2	87.7	-39										82.8	66.6	133.4	16.2
Cable	87.3	87.8	-34										83.4	66.6	138.9	16.8
Enterprise MSS	87.5	87.8	-20										84.6	66.6	152.3	18.0
Enterprise PBX	87.2	87.8	-37										83.0	66.6	135.5	16.4

Note: In red indicates the worst ca

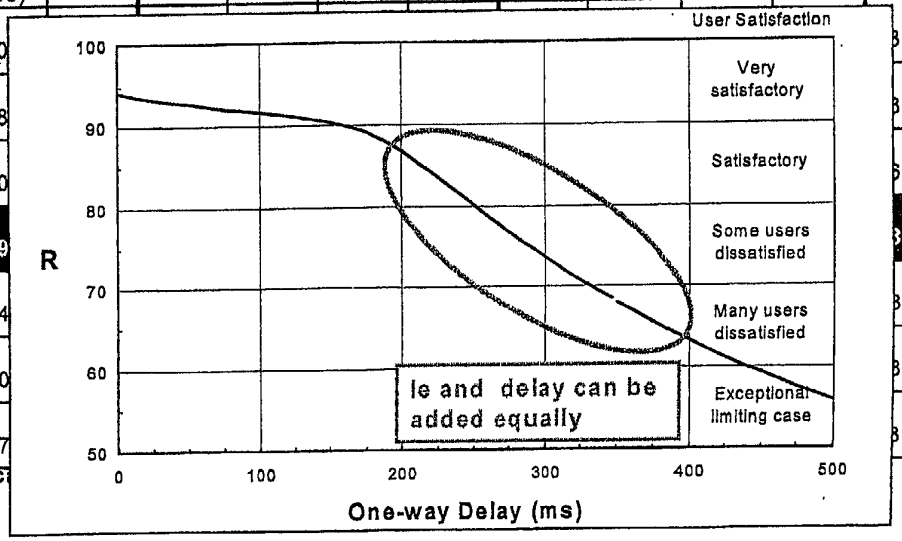


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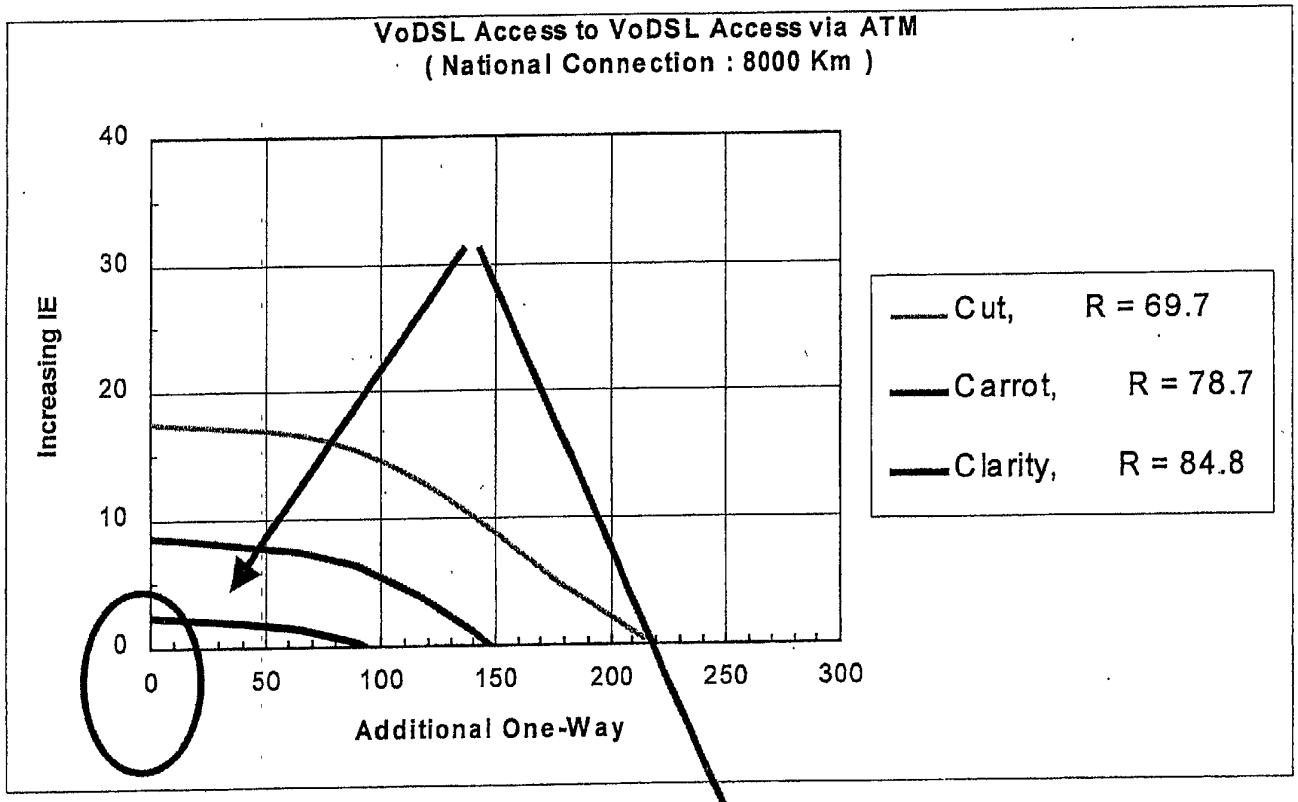
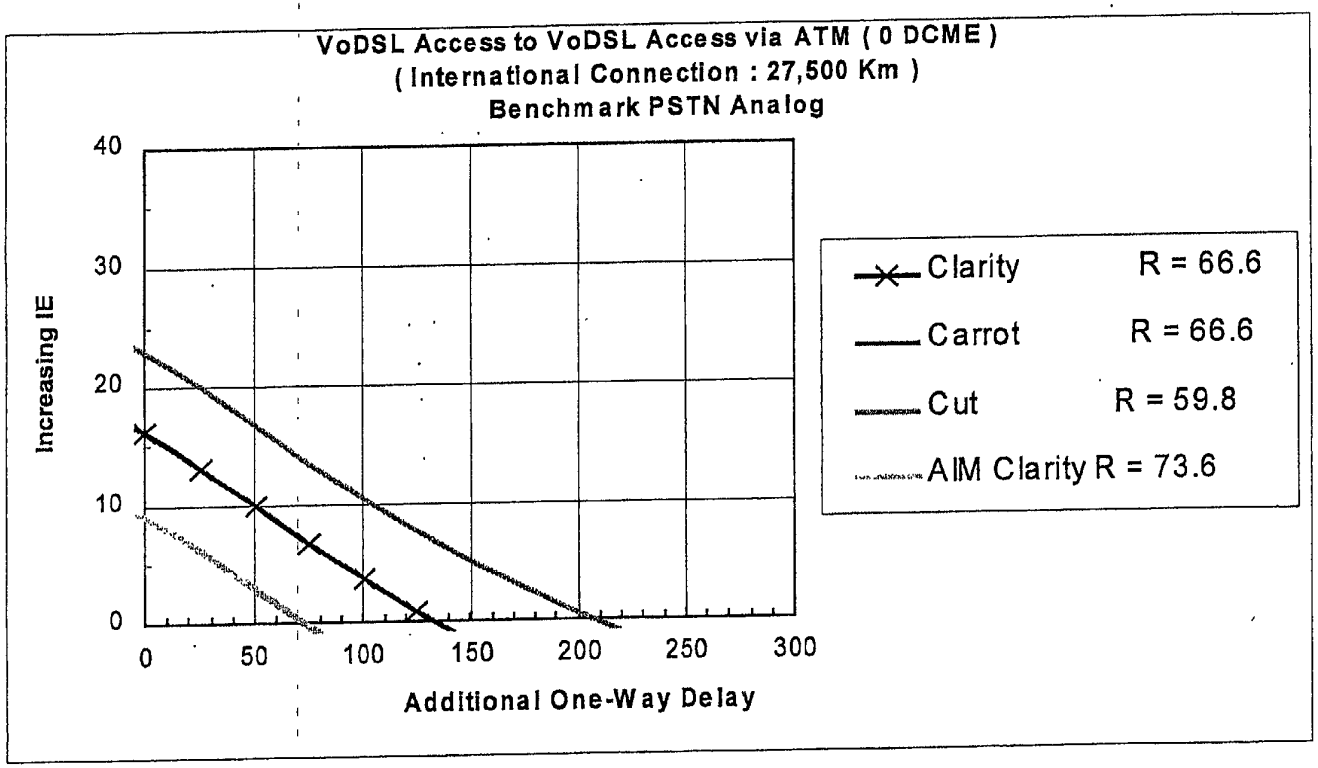
Fig. 57



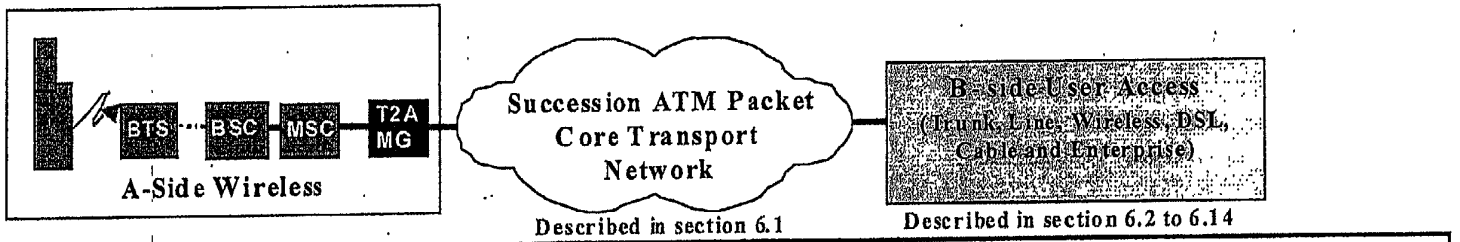
Ie Budget =	2	8	17
Delay Budget =	92	147	219

Fig. 58



Ie Budget =	9.207	16.21	16.21	23.01
Delay Budget =	72.54	133.1	133.1	206

Fig. 59

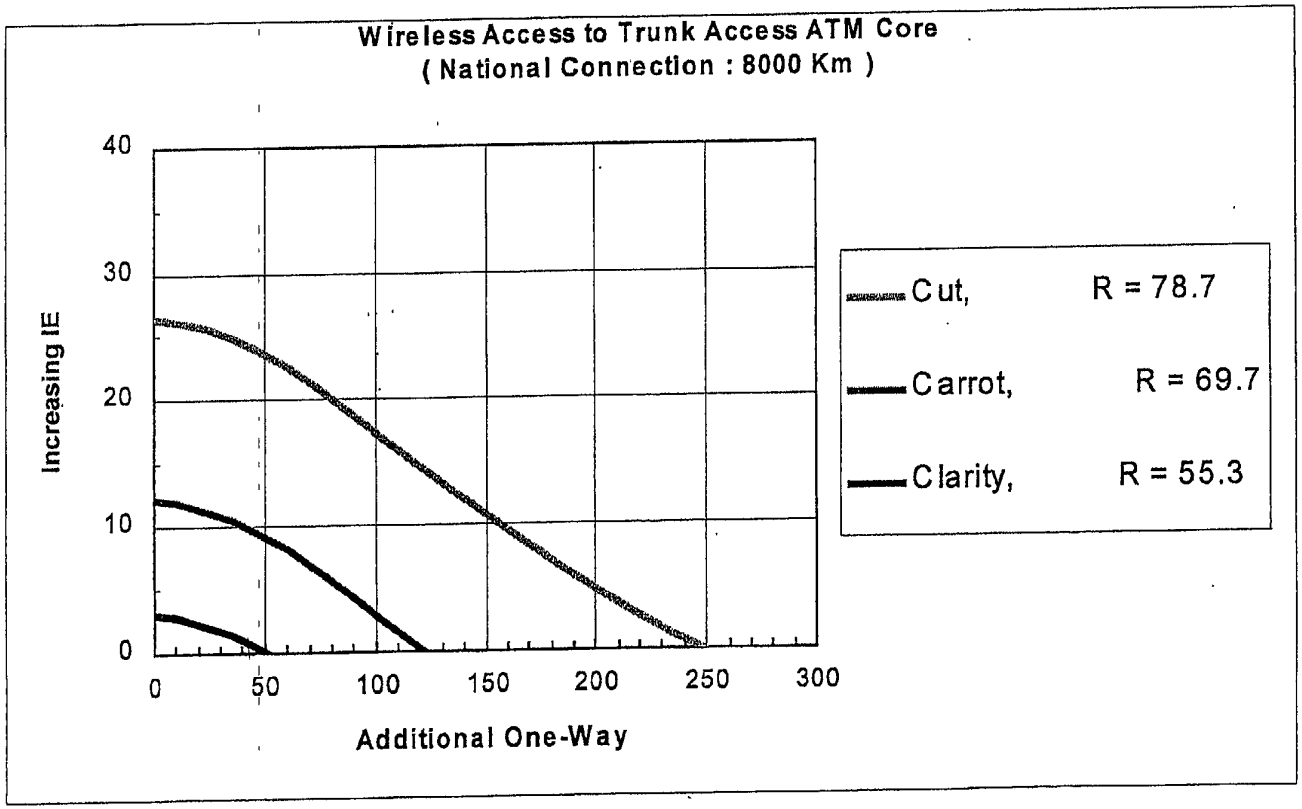


		ATM Core Transport Network															
		Succ vs PSTN National				Succ 0 DCME vs PSTN Intl 0 DCME				Succ 0 DCME vs PSTN Intl 1 DCME				Succ 0 DCME vs PSTN Intl 2 DCME			
		R Succ	R PSTN	Delay Margin (ms)	Ie Margin	R Succ	R PSTN	Delay Margin (ms)	Ie Margin	R Succ	R PSTN	Delay Margin (ms)	Ie Margin	R Succ	R PSTN	Delay Margin (ms)	Ie Margin
B- Side Access	POTS Trunk	81.8	81.7	-1.2	0.1	70.7	70.6	-0.2	0.1	70.7	59.8	91.8	10.9	70.7	49.4	196.8	21.3
	POTS Line	81.8	81.7	1.0	0.1	71.0	70.6	2.0	0.4	71.0	59.8	94.0	11.2	71.0	49.4	199.0	21.6
	Wireless	72.7	72.7	-0.2	0.0	58.5	58.3	0.8	0.2	58.5	48.5	17.8	10.0	58.5	39.0	192.8	19.5
	VoDSL	81.2	81.7	-20.4	-0.5	68.1	70.6	-19.4	-2.5	68.1	59.8	72.6	8.3	68.1	49.4	177.6	18.7
	Cable	81.4	81.7	-14.9	-0.3	68.8	70.6	-13.9	-1.8	68.8	59.8	78.1	9.0	68.8	49.4	183.1	19.4
	Enterprise MSS	81.8	81.7	-1.6	0.1	70.6	70.6	-0.5	0.0	70.6	59.8	91.5	10.8	70.6	49.4	196.5	21.2
	Enterprise IPBE	81.2	81.7	-18.4	-0.5	68.4	70.6	-17.3	-2.2	68.4	59.8	74.7	8.6	68.4	49.4	179.7	19.0

Note: In red indicates the worst case access scenario with the smallest available budget

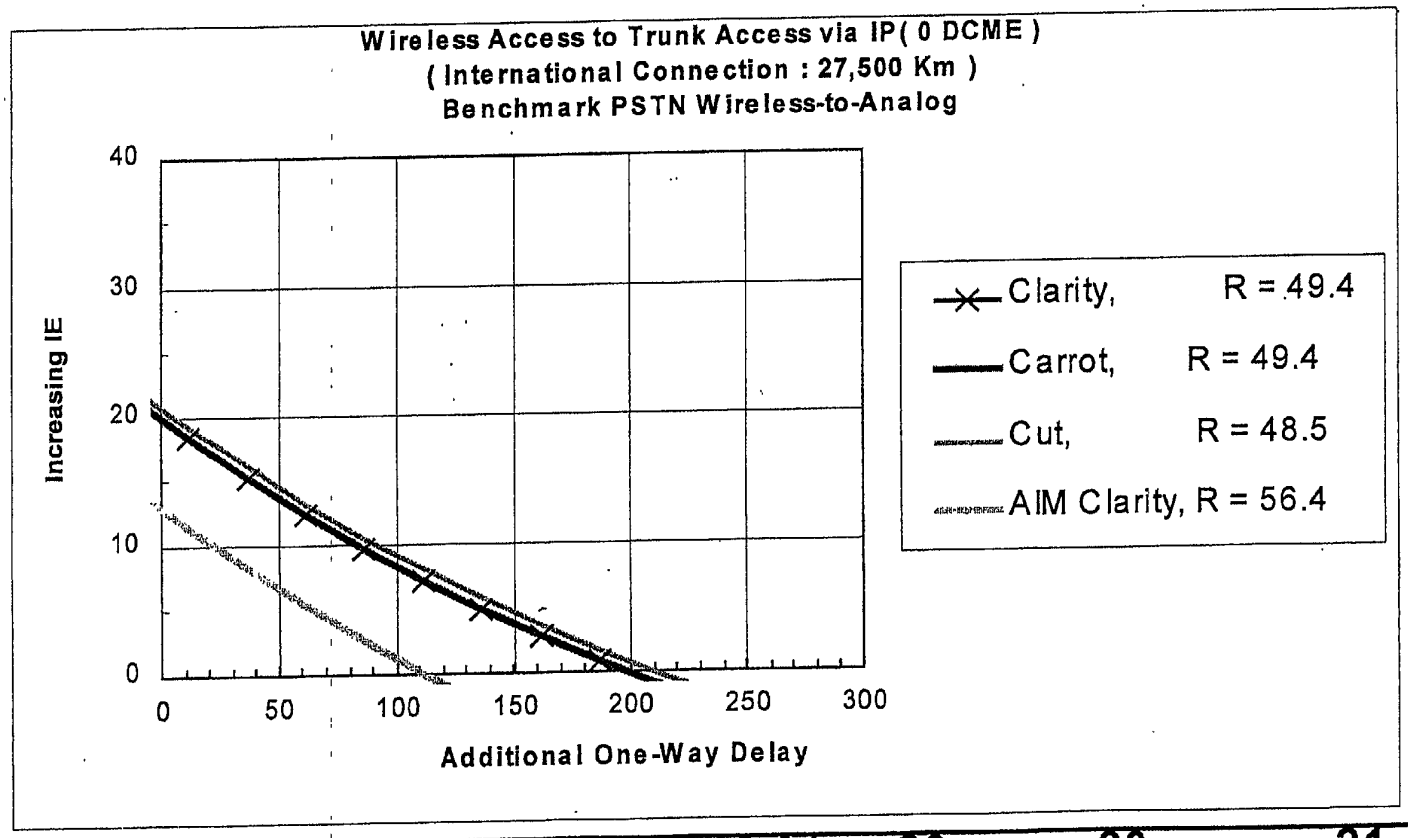
FOUND ON SEARCH

Fig. 60



le Budget =	3	12	26
Delay Budget =	51	121	249

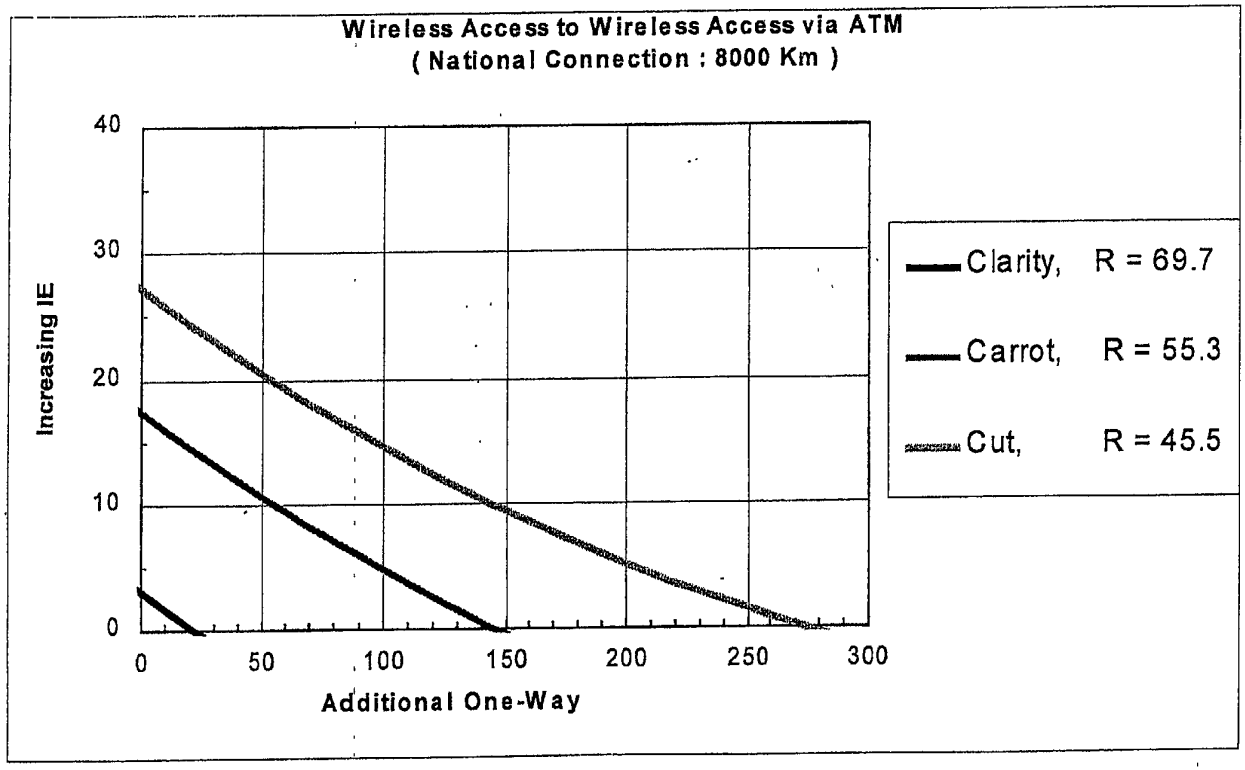
Fig. 61



Ie Budget =	12.91	20	20	21
Delay Budget =	112.4	197	197	210

BUDGET USOTS2CO

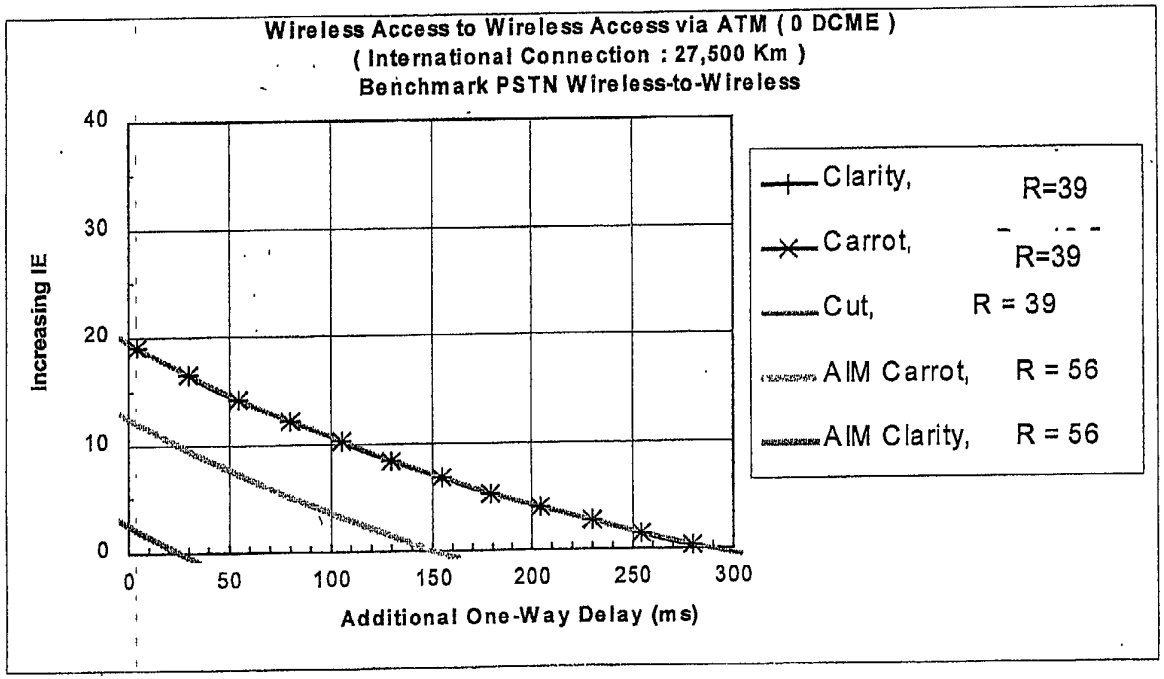
Fig. 62



Delay Budget =	3.004	17.34	27.14
le Budget =	21.97	145.8	273.1

PCT/US00/35256

Fig. 63



Ie Budget =	2	12	19	19	19
Delay Budget =	25	151	181	248	289

Fig. 64

Rank	Codec	E-model Impairment Factor (Ie)	Estimated implementation delay (ms)	Note
1	G.711 at 64 kb/s	0	0.125	PCM
2	G.726 at 32 kb/s with Synch Coding	7	0.250	ADPCM
3	GSM-EFR	5	40	GSM
4	IS-733	*	40	
5	G.728 at 16 kb/s	7	1.250	
6	G.729/G.729A at 8 kb/s	10/11	25	
7	IS-641	6	40	TDMA
8	G.723.1 at 6.3 kb/s (not recommended)	15	30	Soft Phone

Fig. 65

Codec		packetization delay (ms)	max packet loss (%)	le due to packet loss
type	Codec le			
G.711	0	10	0%	0
G.711	0	20	0%	0
G.726(1)	7	10	0%	0

1. This codec is only really suitable for international

PCT/US2003/...

Fig. 66

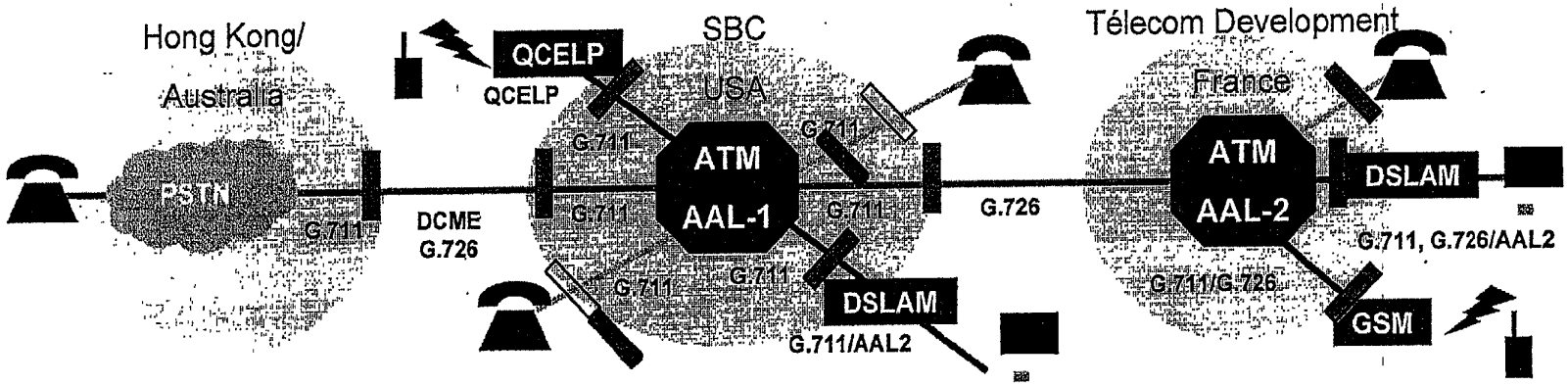
Codec		packetization delay (ms)	max packet loss (%)	le due to packet loss
type	Codec le			
G.711	0	10	0%	0
G.711	0	20	0%	0
G.711	0	40	0%	0
G.726	7	10	0%	0
G.726	7	20	0%	0
G.726	7	40	0%	0
G.711	0	10	1%	5
G.711	0	20	1%	5

FOREIGN DOCUMENT

Fig. 67

Codec		packetization delay (ms)	max packet loss (%)	Ie due to packet loss
type	Codec Ie			
G.711	0	10	0%	0
G.711	0	20	0%	0
G.711	0	40	0%	0
G.726	7	10	0%	0
G.726	7	20	0%	0
G.726	7	40	0%	0
G.729	11	10	0%	0
G.729	11	20	0%	0
G.729	11	40	0%	0
G.711	0	10	1%	5
G.711	0	20	1%	5
G.711	0	40	1%	5
G.726	7	10	1%	2
G.726	7	20	1%	4
G.726	7	40	1%	8
G.729	11	10	1%	2
G.729	11	20	1%	4

Fig. 68


Hong Kong/
Australia
PSTN
G.711
DCME
G.726
QCELP
QCELP
SBC
USA
G.711
G.711
ATM
AAL-1
G.711
G.711
G.711
DSLAM
G.711/AAL2
G.726
Télecom Development
France
ATM
AAL-2
DSLAM
G.711, G.726/AAL2
G.711/G.726
GSM

PCT/IB2003/...

Fig. 69

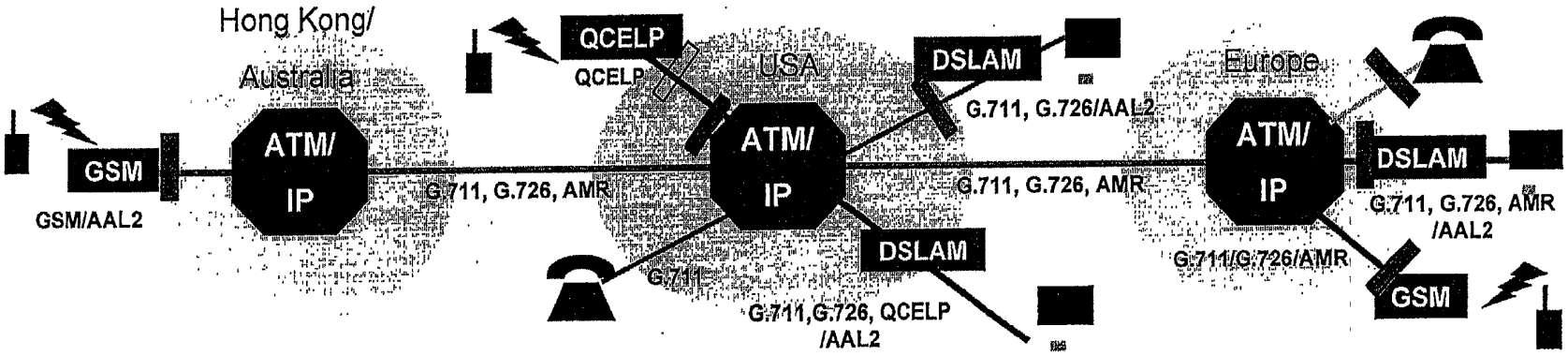


Fig. 70

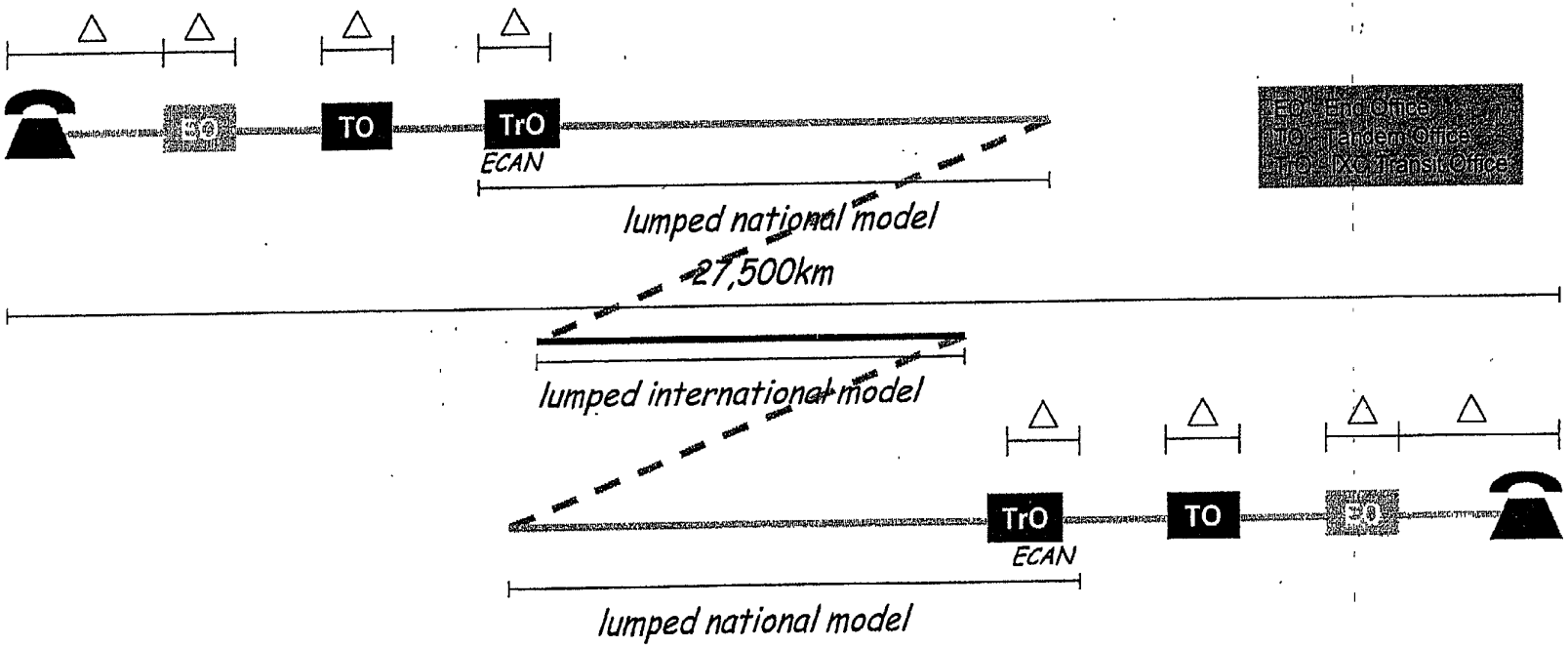
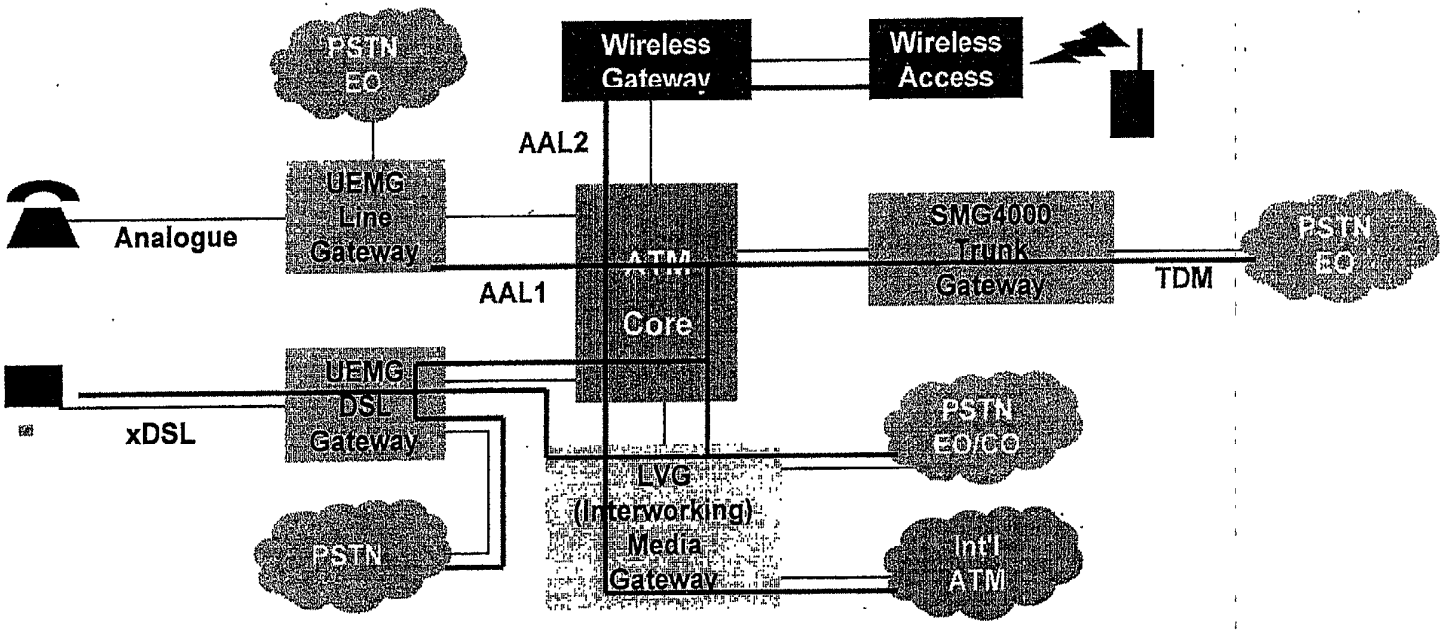
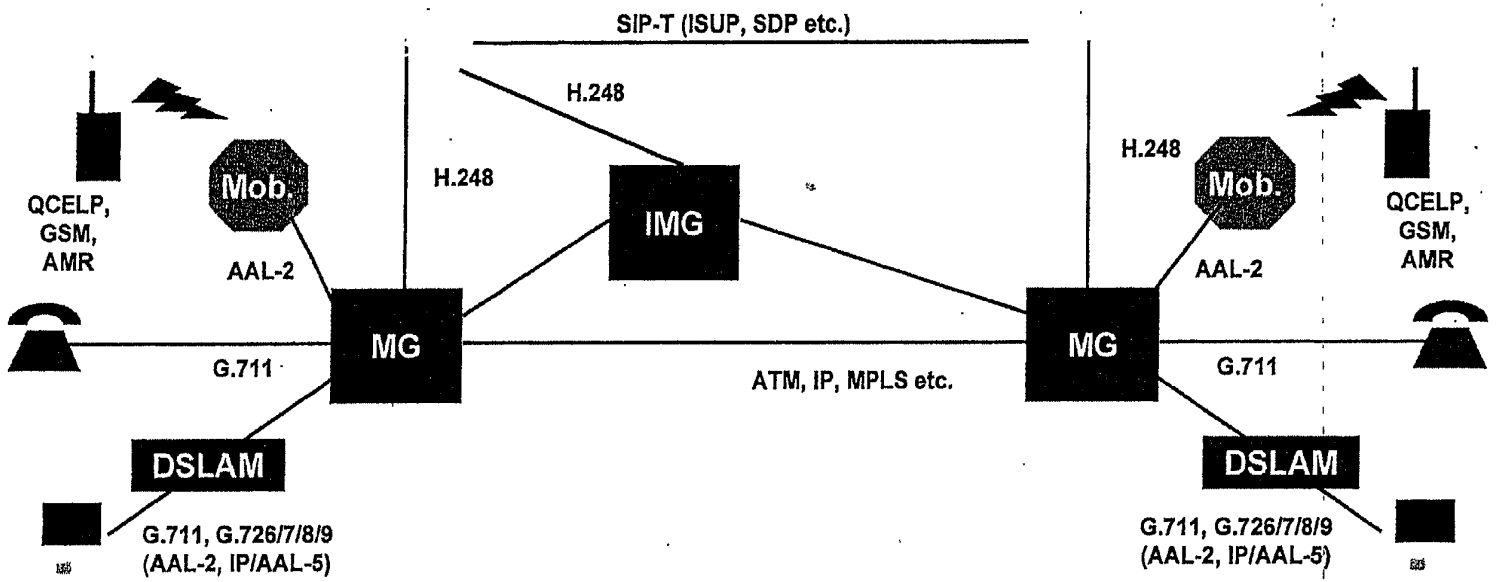

EO
TO
TrO
ECAN
lumped national model
27,500km
lumped international model
TrO
TO
EO
ECAN
lumped national model

Fig. 71


PSTN EO
Wireless Gateway
Wireless Access
AAL2
UEMG Line Gateway
Analogue
AAL1
ATM Core
SMG4000 Trunk Gateway
TDM
PSTN EO
UEMG DSL Gateway
xDSL
PSTN EO/CO
LVG (Interworking) Media Gateway
PSTN
Int'l ATM

PCT/EP2003/050260

Fig. 72



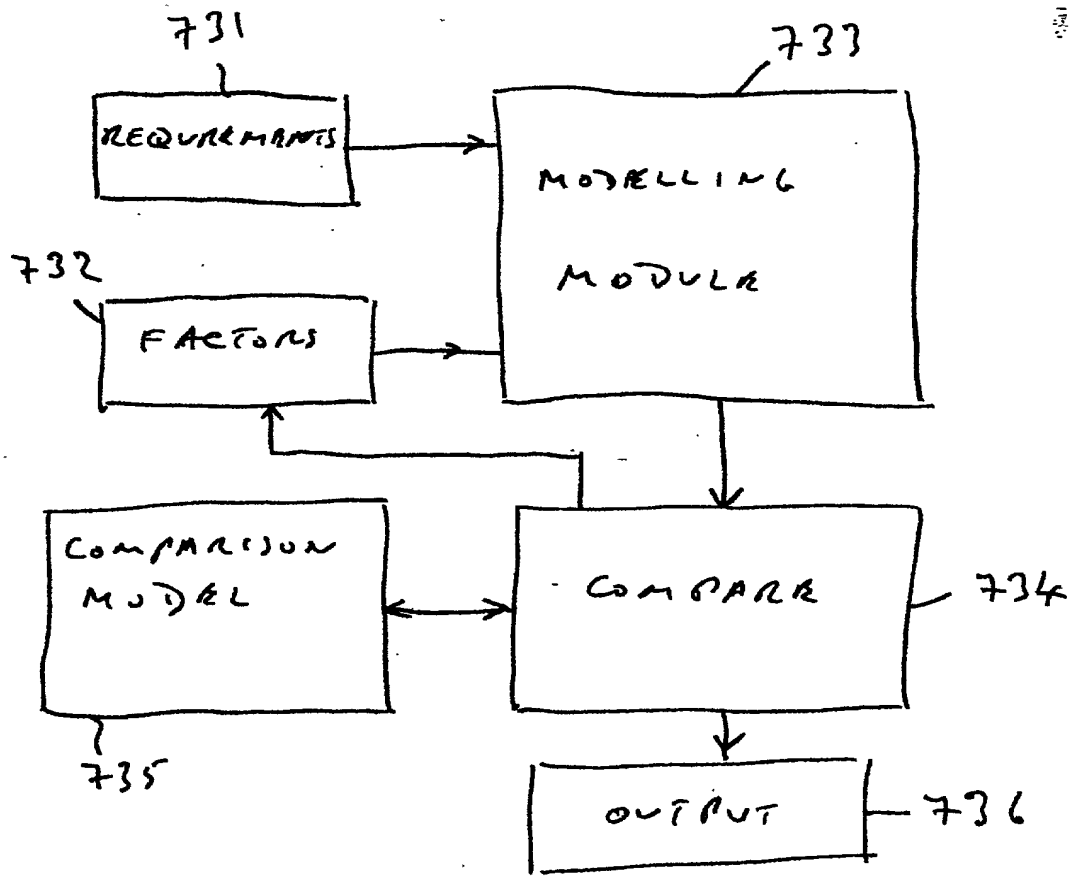

731
REQUIREMENTS
733
MODELLING
MODULE
732
FACTORS
COMPARISON
MODEL
735
COMPARE
734
OUTPUT
736

Fig 73